SEP 20 1911


# JOURNAL OF ELECTRICITY

## POWER AND GAS

**Devoted to the Conversion, Transmission and Distribution of Energy**

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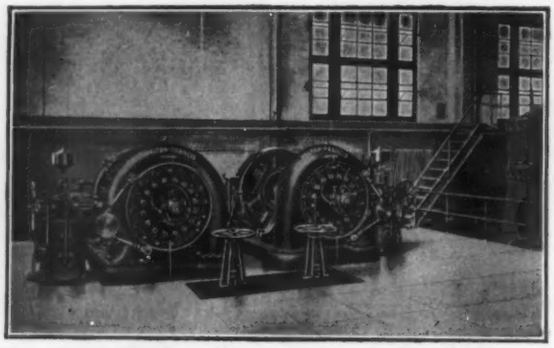

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TO

| Place | Population. |
|---|---|
| Agua Caliente | 50 |
| *Alameda | 27,000 |
| **Albany | 800 |
| ††Alta | 200 |
| Alvarado | 200 |
| Amador | 200 |
| Antioch | 3,000 |
| ††Auburn | 2,050 |
| Barber | 200 |
| **Belmont | 600 |
| Belvedera | 350 |
| Benicia | 2,500 |
| **Berkeley | 42,000 |
| Big Oak Flat | 150 |
| Biggs | 750 |
| Black Diamond | 500 |
| Brentwood | 200 |
| Brighton | 100 |
| Broderick | 500 |
| ‡Brown's Valley | 50 |
| **Burlingame | 5,000 |
| Byron | 200 |
| Campbell | 1,000 |
| Cement | 1,500 |
| ‡Centerville | 20 |
| Centerville | 500 |
| **Chico | 13,000 |
| **Colusa | 2,700 |
| †Colfax | 400 |
| Colma | 500 |
| Concord | 1,500 |
| Cordelia | 150 |
| Corte Madera | 350 |
| Crockett | 2,500 |
| Crow's Landing | 375 |
| Davenport | 1,000 |
| Davis | 750 |
| Decoto | 350 |
| Dixon | 1,000 |
| Dobbins | 50 |
| Drytown | 100 |
| Durham | 500 |
| ‡Dutch Flat | 400 |
| **Easton | 500 |
| **East San Jose | 1,500 |
| Eckley | 20 |
| Emerald | 50 |
| Elmhurst | 2,500 |
| Elmira | 150 |
| El Verano | 100 |
| **Emeryville | 2,000 |
| Encinal | 20 |
| Fairfield | 800 |
| **Fair Oaks | 250 |
| Fitchburg | 250 |
| Folsom | 1,500 |
| *Fresno | 35,000 |
| Glenn Ellen | 500 |
| Gold Run | 100 |
| Grafton | 350 |
| †Grass Valley | 7,000 |
| Gridley | 1,800 |
| Groveland | 50 |
| Hammonton | 500 |
| Hayward | 4,000 |
| Hollister | 3,000 |
| Ione | 500 |
| Irvington | 1,000 |
| Jackson | 2,000 |
| Jackson Gate | 50 |
| Larkspur | 950 |
| Lawrence | 100 |
| Kennedy Flat | 50 |
| Kentfield | 200 |
| ‡Lincoln | 1,500 |
| †live Oak | 200 |
| Livermore | 2,250 |
| ‡Loomis | 150 |
| Los Altos | 200 |
| Los Gatos | 3,000 |
| Mare Island | 500 |
| Martell | 25 |
| Martinez | 5,000 |
| **Marysville | 6,250 |
| Mayfield | 1,500 |
| **Menlo Park | 1,500 |
| Meridian | 300 |
| **Milbrae | 300 |
| Mill Valley | 4,500 |
| Mission San Jose | 500 |
| Mokelumne Hill | 150 |
| Mountain View | 2,500 |
| **Napa | 6,000 |
| †Nevada City | 4,000 |
| Newark | 700 |
| ‡Newcastle | 600 |
| New Chicago | 25 |
| Newman | 1,000 |
| Niles | 800 |
| **Oakland | 230,000 |
| Oroville | 2,500 |
| Orwood | 50 |
| Pacheco | 200 |
| **Palo Alto | 6,000 |
| ‡Penryn | 250 |
| Perkins | 200 |
| **Petaluma | 6,000 |
| Peyton | 250 |
| **Piedmont | 2,000 |
| Pinole | 1,500 |
| Pleasanton | 2,000 |
| Port Costa | 600 |
| **Redwood City | 3,500 |
| Richmond | 10,000 |
| Rio Vista | 200 |
| ‡Rocklin | 1,050 |
| Rodeo | 100 |
| ‡Roseville | 345 |
| Ross | 900 |
| ***Sacramento | 52,000 |
| San Andreas | 200 |
| San Anselmo | 2,500 |
| San Bruno | 1,500 |
| San Carlos | 100 |
| **San Francisco | 450,000 |
| **San Jose | 40,000 |
| San Leandro | 4,000 |
| San Lorenzo | 100 |
| **San Mateo | 7,000 |
| San Pablo | 1,000 |
| **San Quentin Prison | 1,600 |
| **San Rafael | 6,000 |
| Santa Clara | 8,000 |
| Santa Cruz | 10,000 |
| **Santa Rosa | 8,000 |
| Saratoga | 200 |
| Sausalito | 3,000 |
| Sebastopol | 2,000 |
| Selby | 100 |
| Sonoma | 1,200 |
| South San Fran | 2,500 |
| Stanford University | 2,000 |
| Stege | 100 |
| ‡Stockton | 25,000 |
| Suisun | 1,200 |
| Sunnyvale | 2,000 |
| Sutter Creek | 2,000 |
| Tiburon | 100 |
| Tormey | 150 |
| ‡Towle | 200 |
| Tracy | 1,200 |
| Vacaville | 2,500 |
| **Vallejo | 12,000 |
| Vallejo Junction | 10 |
| Walnut Creek | 350 |
| Wheatland | 1,400 |
| Winters | 1,200 |
| **Woodland | 3,500 |
| Yolo | 350 |
| **Yuba City | 1,900 |

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| Service Furnished | Number of Towns | Total Population |
|---|---|---|
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| Water | 17 | 43,415 |
| Street Car | 1 | 52,000 |

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# AN ELECTRIC GAS METER TEST

BY J. C. WILSON[1]

While Professor Carl C. Thomas of the University of Wisconsin was making his investigations on the specific heat of superheated steam he made use of an electric heater as a means of introducing a measurable amount of heat into flowing steam. The weight of steam flowing per unit of time could easily be obtained by condensation and weighing. By measuring the rise in temperature produced in a measured quantity of steam by a measured quantity of heat the specific heat of the steam was directly obtained. During these experiments it occurred to him that if a measurable amount of heat could be added to a superheated gas having a known specific heat and the resultant temperature change could be measured the weight of gas would be directly obtainable, that is, he would have a meter. From this idea has developed a new and novel meter which will actually weigh air or gas at it flows through a pipe.

This fundamental property of measuring the quantity of matter flowing per unit of time instead of the volume that this matter occupies under some certain conditions of pressure and temperature makes this meter especially applicable to a very broad field of measurement. It can be used for measuring ventilating air at low pressure or compressed air used in the various industries, natural gas with its very high pressures, or artificial gases in any condition of pressure and temperature, and in all of these cases give continuous graphical or integrated results directly in any standard unit which is based upon the quantity of stuff contained in it.

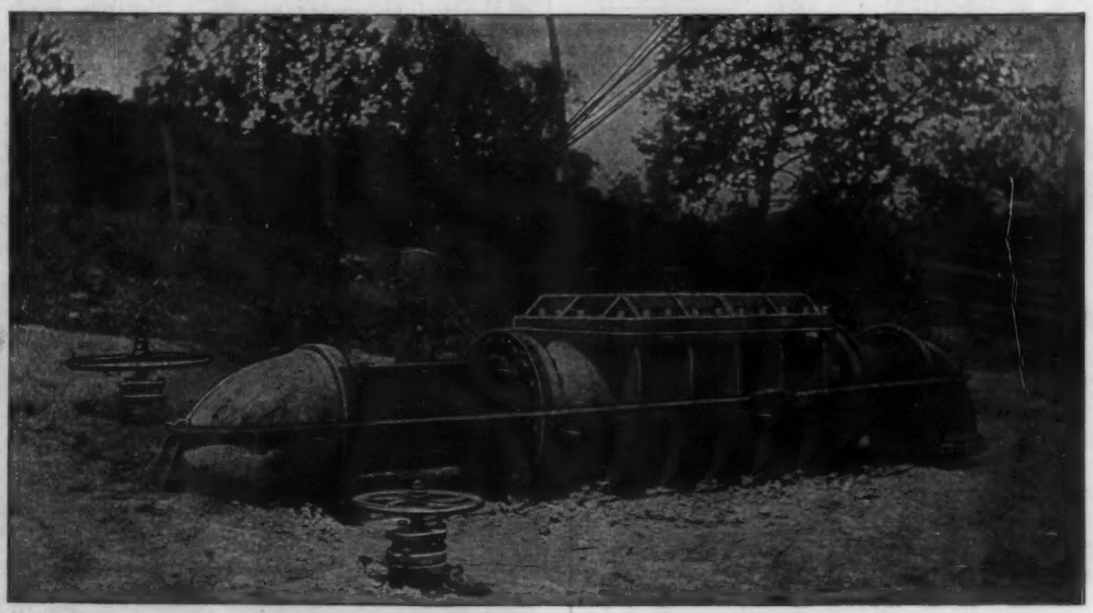

Fig. 1. Casing of Electric Gas Meter Installed in a Natural Gas Line.

A meter that could be used for so broad a service seemed well worth developing into a commercial form. The first meters were designed for the introduction into the flowing gas of a constant supply of heat, which was accomplished by passing electric current through a resistance material evenly distributed over the section of the passage. The resultant rise in temperature was measured and recorded by means of a temperature difference recording device operated in connection with resistance thermometers

[1] Electrical Engineer, Cutler-Hammer Co., Milwaukee.

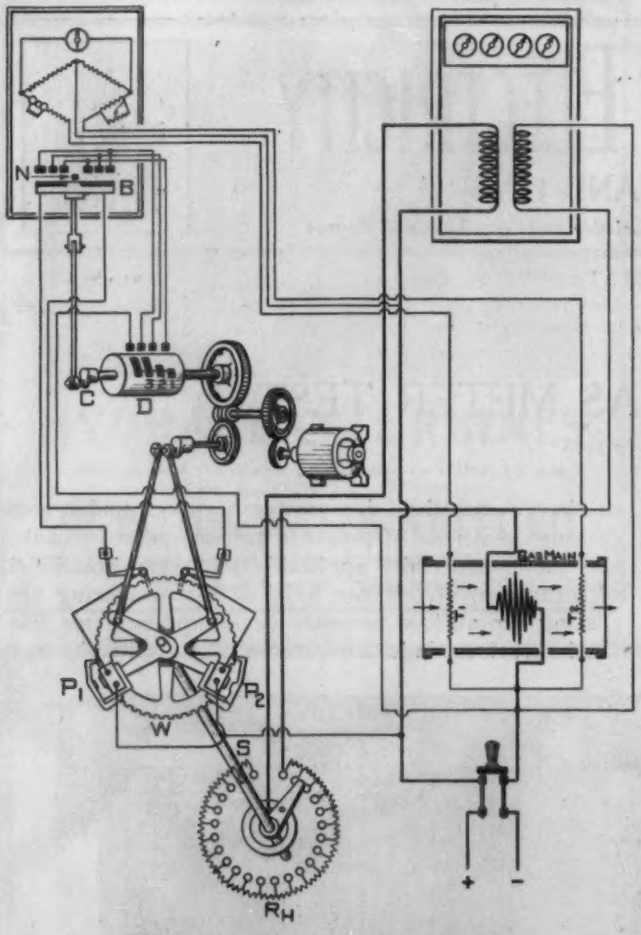


Fig. 2. Diagram of Electric Gas Meter Connections.

unit in the gas main. Since the specific heat of any given gas is constant under all working conditions of temperature and pressure, the temperature rise caused by a constant heat supply was inversely proportional to the rate of flow of gas. The temperature difference recorder was arranged to read in standard cubic feet instead of in degrees of temperature difference. This design had some disadvantages. A constant supply of electrical energy to a heater is not a simple problem commercially, and although temperature differences can be measured and recorded very accurately, the results were obtained by an inverse proportion instead of a direct one and they could not be integrated. However, it was one of the steps through which all devices must pass in their development and some very valuable results were obtained with this type of meter as will be explained later.

It was soon seen that if the temperature increase could be kept constant and of a known value for all variations in rate of flow, the amount of heat energy required to maintain this constant temperature increase would be directly proportional to the rate of flow. Since this heat is furnished in the form of electrical energy it could be measured by means of a wattmeter and if it could be automatically regulated to maintain a constant temperature increase in the gas, the problem of a successful commercial meter would be solved. Either a graphical or integrating wattmeter or both could be used and they could be made to read directly in standard units of gas instead of in watts. The problem of automatically regulating the heater energy to maintain a constant temperature increase was worked out as follows:

Referring to Fig. 2, the two thermometers $T_1$ and $T_2$ are made two arms of a Wheatstone bridge. These thermometers are on opposite sides of the heater unit and consist of a resistance material evenly distributed over the section of the pipe. This resistance material has a positive temperature coefficient, that is, it increases its resistance with an increase in temperature. The other two arms of the Wheatstone bridge are fixed coils of resistance wire having a zero temperature coefficient. Across the bridge is a galvanometer of the flat coil type so arranged that any unbalancing of resistances in the bridge causes a deflection of the needle. The bridge operates on a balanced condition and it remains balanced so long as the flow of gas remains constant. The deflections of the galvanometer needle caused by changes in rate of flow are utilized to regulate the heater energy so as to restore the bridge to its balanced condition.

In series with the heater is a rheostat $R_h$ on the shaft of which is a toothed wheel W. The deflections of the galvanometer needle N must be made to move this wheel. As this needle has no power of the magnitude required to do this work a small continuous running motor is arranged to furnish this power. Through gears and eccentrics this motor causes the two pawls P and $P_1$ to move with a vertical reciprocating motion through an arc equal to the length of three teeth. These pawls are pulled into engagement by means of magnets. The motor also drives a

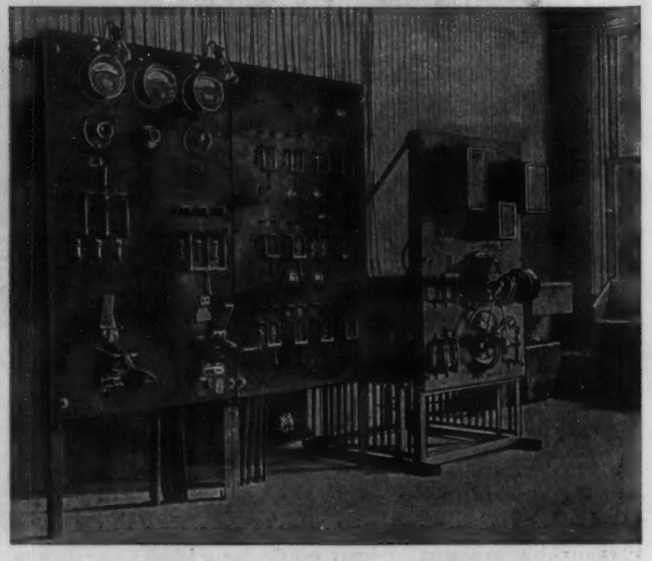

Fig. 3. Meter Recording Panel Installed Alongside of Switchboards in the Generator Station.

crank C which causes the needle to be clamped periodically between two sets of contacts. On the crank shaft is a drum carrying segments of different lengths. If the needle should be clamped in its extreme right hand position the pawl $P_1$ would be pulled in by its magnet to engage the toothed wheel at the bottom of its stroke and it would remain engaged throughout its upward stroke, thus moving the rheostat arm three steps. If the needle is clamped one division

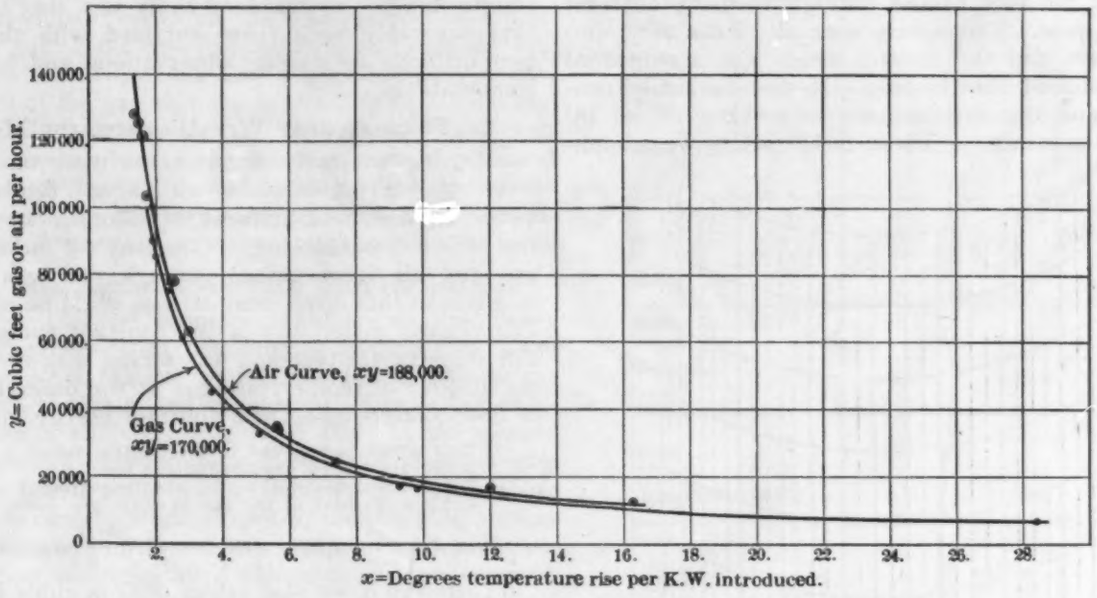


Fig. 4. Curves for Test of Thomas Meter Against Wet Displacement Meter.

to the right of its central position the pawl is engaged only during the last one-third of its stroke and the rheostat arm is moved one step. Thus a small or large increase or decrease in the rate of flow of gas causes the heater energy to be increased or decreased a corresponding amount so as to maintain the temperature increase constant.

With the heater current broken and with gas flowing through the meter so that the two thermometers have the same temperature, the galvanometer is balanced by means of a small rheostat in series with the exit thermometer. The entrance and exit thermometer circuits then have the same resistance. A resistance is then inserted in the $T_1$ circuit equal in value to the increase in resistance in thermometer $T_2$ corresponding to a temperature change of about two degrees F. The heater current is thrown in and the control device automatically increases the heater energy until the bridge again balances, that is, until thermometer $T_2$ has been brought to a temperature two degrees higher than $T_1$ and this balanced condition is maintained in spite of variations in rate of flow. Since the increase in temperature is thus maintained a constant the value of which is determined by the amount of the temperature difference resistance inserted in series with the entrance thermometer, it only remains to measure the electrical energy supplied to the heater in order to have a direct measure of the rate of flow of gas. This is accomplished with a commercial wattmeter.

The heater and thermometer units are mounted in a sheet metal barrel and this barrel is in turn inserted in a cast iron casing designed to suit any desired pressure. (See Fig. 1). A gas jacket is provided to reduce radiation losses to a minimum. From this casing the electrical connections lead to the recording panel having mounted on it the automatic control device, the regulating rheostat, and the recording instruments. (See Fig. 3).

### 1. Laboratory Tests.

Very extensive tests were made on the electric type of meter against the Pitot Tube and the Venturi Meter in the Gas Engineering Laboratory of the University of Wisconsin. In these tests all three meters were inserted in series in the same pipe

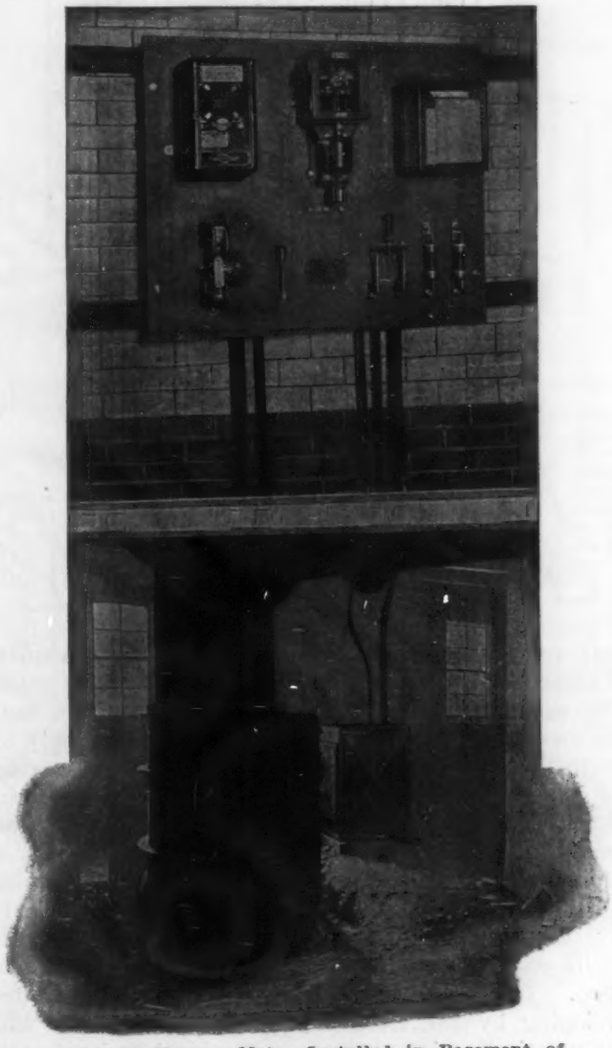

Fig. 5. Thomas Meter Installed in Basement of Pumping Station with Recording Panel on Main Floor Above.

line and air was passed through them at different rates of flow. The meters were all of the very simplest form and the electric meter was arranged to give indicated results only. It was manually controlled and the observations were taken on an indicating wattmeter. These three meters were appli-

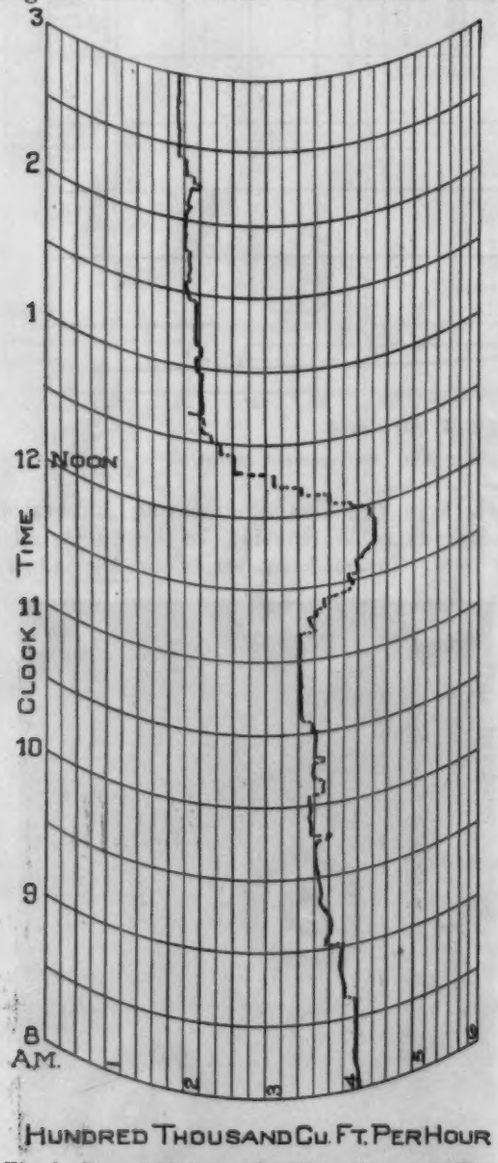


Fig. 6. Record Made by New Meter Shown in Fig. 5 on Which is Seen the Noon Peak Load in a City's Gas Supply.

cations of three fundamentally different principles. Independent observations were very carefully made for each and the calculations were made from fundamental theories only. We have space here only to note that these three different methods of measuring a common quantity gave results that differed from each other by very small percentages throughout the range of flow. These tests established beyond a doubt the soundness of the fundamental principles of the electric meter and also brought out very clearly the ease of taking observations and obtaining results with this method as compared with the other two. They also emphasized the possibility of developing by the electric method a meter that will automatically give continuous graphical or integrated results directly in standard cubic feet that compare very favorably with those obtained with the other two methods by careful observations and laborious computations.

**2. Tests Against Wet Displacement Meter.**

During the early development work an electric meter was tested in series with a wet displacement meter for the measurement of illuminating gas in the Milwaukee Gas Light Company's Works. Both gas and air were passed through the two meters in series so that direct comparisons could be obtained. The electric meter was of the constant energy variable temperature type and was arranged to record the the amount of temperature rise at the different rates of flow corresponding to a constant energy input

If E = kilowatts supplied to the electric meter.
G = cubic feet of gas flowing per hour.
T = temperature rise in the gas in degrees F.
S = Specific heat of the gas in B.t.u. per cubic foot.

$$\text{Then } E \times 3412 = G\,S\,T \text{ and } G \times \frac{T}{E} = \frac{3412}{S} = \text{constant.}$$

Therefore if we plot values of G in cubic feet per hour obtained by the wet meter as ordinates and corresponding values of $\frac{T}{E}$ obtained from the electric meter as abscissas, the resultant curves must be rectangular hyperboles. Fig. 4 shows the points plotted for both the gas and air tests with rectangular hyperbolas drawn through them. From the gas curve

$$G \times \frac{T}{E} = 170{,}000 = \frac{3412}{S}$$

and S, the specific heat of the gas, as found to be 0.0201. Similarly the specific heat of air computed from the air curve = 0.0181. The conditions of the gas and air during the tests were as follows:

| | Gas | Air |
|---|---|---|
| Temperature, Fahrenheit | 50 | 60 |
| Pressure, Inches Water | 6 | 6.5 |
| Barometer | 29.8 | 29.75 |

Reducing the values of specific heat obtained from the tests as shown above to standard conditions of 32 degrees F. and 29.9" mercury, S for the gas becomes 0.0210 which is to be compared with the specific heat computed from the analysis of the gas given below.

| | Vol. cu. ft. | Weight per cu. ft. lb. | Total Weight lb. | Specific Heat per lb. | Specific Heat per cu ft. |
|---|---|---|---|---|---|
| $CO_2$ | 0.04 | 0.11637 | 0.004658 | 0.216 | 0.00100 |
| $C_2H_4$ | 0.11 | 0.0741 | 0.00815 | 0.404 | 0.00329 |
| $O_2$ | 0.001 | 0.08463 | 0.00085 | 0.217 | 0.00023 |
| CO | 0.331 | 0.07407 | 0.02450 | 0.245 | 0.00600 |
| $CH_4$ | 0.1761 | 0.04234 | 0.00746 | 0.593 | 0.00442 |
| $H_2$ | 0.303 | 0.00530 | 0.00160 | 3.409 | 0.00546 |
| $N_2$ | 0.0389 | 0.07429 | 0.00289 | 0.244 | 0.00071 |
| | | | | | 0.02111 |

Similarly the specific heat of air reduced to standard conditions of 32 degress and 29.9" mercury becomes S = 0.0191 which is to be compared with the generally accepted value of 0.0192 B.t.u. per cubic foot for air under these conditions. These tests, especially those with air whose specific heat is well known, provide very good evidence of the accuracy of the electric meter as compared with the wet displacement meter which is generally accepted to be most accurate and reliable for artificial gas measurement.

Fig. 5 shows a typical installation of the commercial electric meter for the measurement of illuminating gas. This meter installed in the pumping station of the Milwaukee Gas Light Company, measures all of the gas supplied to the City of Milwaukee. It has a maximum capacity of 3,000,000 cubic feet of free gas per hour. Fig. 6 is a portion of graphical chart made by this meter showing the shape of the peak curve in the city's supply caused by the increased demand for gas for cooking purposes at noon.

### 3. Tests Against Pitot Tube With Natural Gas.

Fig. 1 shows a meter installed at the Brave Pumping Station of the Peoples Natural Gas Company of Pittsburg for the measurement of natural gas between the wells and the pumps. The casing is located in a field just above the level of the ground immediately between two elbows and close to gate valves and is in a 10-inch suction line within about 200 feet of the suction header of the pumping station. From this casing the electric connections lead to the recording panel installed alongside the switchboards in the lighting plant from which the meter receives its supply of energy. (See Fig. 3). This meter has a maximum capacity of 750,000 cubic feet of free gas per hour and an accurate minimum capacity of 12,500 cubic feet. It is designed to give a graphical record as well as integrated values of flow directly in standard cubic feet at 15.025 pounds pressure and 60 degrees F. although the pressure of the gas in the line varies from 50 to 200 pounds gauge and the temperature varies with weather conditions. The specific heat of the standard unit was computed for the design of the meter from an analysis assumed from an average, and to correspond to the standard pressure and temperature stated above.

This installation afforded an unusual opportunity for checking the accuracy of the meter on account of the very wide and rapid variations in the pressure and rate of flow of the gas in the ordinary operation of the system, and also because there was installed at Bula a very complete and thoroughly calibrated Pitot Tube Station, one tube of which was in the same line with the Thomas meter. The two meters could thus be run in series although they were separated by about one and one-half miles of 10-inch pipe. Readings of pressure and velocity head were taken on the Pitot tube every fifteen minutes day and night, and from these readings values of gas flow in standard cubic feet were obtained by the use of carefully prepared tables. Since these tables reduced the Pitot Tube readings to the same standard units in which the Thomas Meter was designed to read, the results were directly comparable.

Very thorough tests were made on the Thomas meter under service conditions to determine the degree of accuracy with which it would give continuous results directly in standard cubic feet with variable pressures, temperatures, and rates of flow, as compared with the results obtained by very frequent and careful observations on the Pitot tubes, and also to learn whether all the parts would stand up satisfactorily against wear and the action of the gas.

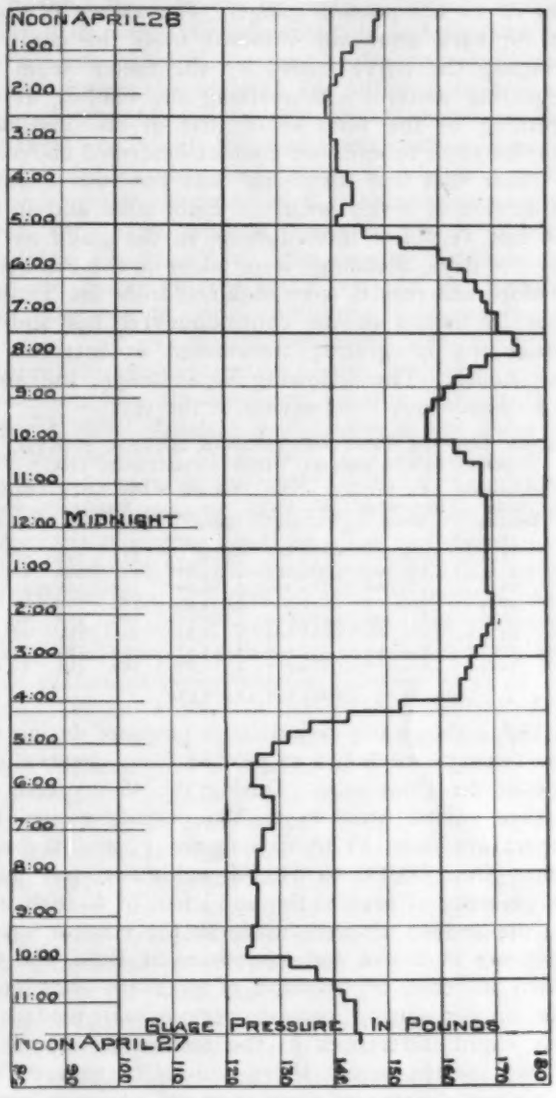


Fig. 7. Pressure Log for 24-hour Period of Test on Thomas Meter with Natural Gas.

HOURLY RESULTS OF 22-HOUR TEST OF THOMAS METER.

| | Cubic Feet Each Hour | | | Total Cu. Ft. at end of Each Hour | | |
|---|---|---|---|---|---|---|
| Hour | Chart | Integrating Meter | Pitot Tube | Chart | Integrating Meter | Pitot Tube |
| 8-9 | 397,500 | 400,000 | 400,297 | 397,500 | 400,000 | 400,297 |
| 9-10 | 398,500 | 398,000 | 394,027 | 796,000 | 798,000 | 794,324 |
| 10-11 | 370,000 | 374,000 | 373,731 | 1,166,000 | 1,172,000 | 1,168,055 |
| 11-12 | 376,500 | 377,000 | 380,800 | 1,542,500 | 1,549,000 | 1,548,855 |
| 12- 1 | 361,500 | 364,000 | 367,726 | 1,904,000 | 1,913,000 | 1,916,581 |
| 1- 2 | 370,900 | 377,000 | 377,694 | 2,274,900 | 2,290,000 | 2,294,275 |
| 2- 3 | 381,200 | 387,500 | 386,103 | 2,656,100 | 2,677,500 | 2,680,378 |
| 3- 4 | 380,900 | 386,500 | 387,815 | 3,037,000 | 3,064,000 | 3,068,190 |
| 4- 5 | 382,600 | 384,000 | 387,229 | 3,419,600 | 3,448,000 | 3,455,419 |
| 5- 6 | 385,510 | 388,000 | 389,052 | 3,805,110 | 3,836,000 | 3,844,471 |
| 6- 7 | 391,250 | 388,000 | 392,161 | 4,196,360 | 4,224,000 | 4,236,632 |
| 7- 8 | 395,000 | 391,000 | 394,654 | 4,591,360 | 4,615,000 | 4,631,286 |
| 8- 9 | 394,500 | 392,000 | 392,416 | 4,985,860 | 5,007,000 | 5,023,702 |
| 9-10 | 397,500 | 398,000 | 392,245 | 5,383,360 | 5,405,000 | 5,415,947 |
| 10-11 | 387,000 | 383,000 | 385,383 | 5,770,360 | 5,788,000 | 5,801,330 |
| 11-12 | 388,000 | 387,000 | 387,104 | 6,158,360 | 6,175,000 | 6,188,434 |
| 12- 1 | 378,000 | 373,000 | 386,983 | 6,536,360 | 6,548,000 | 6,575,417 |
| 1- 2 | 439,500 | 436,000 | 435,416 | 6,975,860 | 6,984,000 | 7,010,833 |
| 2- 3 | 447,000 | 446,000 | 445,945 | 7,922,860 | 7,430,000 | 7,456,778 |
| 3- 4 | 463,000 | 459,000 | 465,896 | 7,885,860 | 7,889,000 | 7,922,674 |
| 4- 5 | 465,000 | 464,000 | 467,240 | 8,350,860 | 8,353,000 | 8,389,914 |
| 5- 6 | 407,500 | 411,000 | 394,886 | 8,758,360 | 8,764,000 | 8,784,800 |

The above table shows the hourly results of a comparative test of twenty-two hours duration. During a large part of this test the rate of flow was kept nearly constant and the temperature of the gas remained about the same but the pressure varied

from 72 to 123 pounds gauge. The values of cubic feet for each hour are obtained from the chart by averaging the curve traced by the meter, from the integrating meter by subtracting the reading at the beginning of the hour from that at the end, and from the Pitot tube in the manner described above.

After this test the meter was put into continuous service in series with the Pitot tube and it ran with but very few interruptions in the gas flow for forty-five days. Readings were taken on the Pitot tube as before and results were obtained from the Thomas meter by means of the continuous records and by reading the integrating instrument at intervals of three hours. The following is a sample log sheet for a twenty-four hour period of the test:

24-HOUR LOG OF TEST OF THOMAS METER, BRAVE, PA. NOON APRIL 26th TO NOON APRIL 27th, 1911.

| Time | Integrating Meter Reading | Cu. Ft. Integrating Meter | Cu. Ft. Chart | Cu. Ft. Pitot Tube | Pressure Brave | Pressure Bula | Temperature Brave | Temperature Bula |
|---|---|---|---|---|---|---|---|---|
| 12:00 | 2498.0 | | | | | | | |
| 3:00 | 2602.6 | 1,056,000 | 1,030,800 | 1,056,536 | 134 | 140 | 47 | 46 |
| 6:00 | 2714.3 | 1,107,000 | 1,073,400 | 1,115,176 | 157 | 161 | 47 | 43 |
| 9:00 | 2831.7 | 1,174,000 | 1,134,000 | 1,160,802 | 156 | 160 | 47 | 43 |
| 12:00 | 2965.0 | 1,333,000 | 1,321,200 | 1,311,671 | 162 | 167 | 47 | 43 |
| 3:00 | 3086.7 | 1,217,000 | 1,230,600 | 1,226,774 | 162 | 166 | 47 | 42 |
| 6:00 | 3215.0 | 1,283,000 | 1,302,900 | 1,310,577 | 114 | 124 | 47 | 40 |
| 9:00 | 3375.0 | 1,600,000 | 1,631,400 | 1,614,811 | 113 | 125 | 47 | 40 |
| 12:00 | 3523.2 | 1,482,000 | 1,479,000 | 1,480,000 | 135 | 143 | 47 | 46 |
| Totals | | 10,252,000 | 10,203,300 | 10,276,350 | | | | |

Fig. 7 shows the variations in pressure during the same twenty-four hours as plotted from observations made at the Pitot tube. During the 45-day test the pressure varied from 46 to 185 pounds gauge, the temperature from 45 to 65 degrees F. and the rate of flow from 90,000 to 640,000 cubic feet per hour. The presence of several thousand feet of 10-inch pipe line, the sudden changes made in the control valves sometimes at Brave and sometimes at Bula, and the sudden increase or decrease of pressure over quite wide ranges during certain periods, all tended to cause slight differences in the results as shown by the two meters during short periods of time. That these slight differences were averaged out over longer periods is shown by the following summary of the two tests:

28-HOUR TEST, APRIL 9th AND 10th, 1911.

Total standard cubic feet of gas for 22 hours by Pitot tube . . . . . 8,784,800

Total standard cubic feet of gas for 22 hours by Thomas meter . . . . . 8,764,000

$$\frac{8,784,800 - 8,764,000}{8,784,800} = 0.2\% \text{ difference.}$$

ENDURANCE TEST APRIL 17th TO JUNE 3d, 1911.

Total standard cubic feet of gas by Pitot tube. . . . . 337,546,182

Total standard cubic feet of gas by Thomas Meter. . 336,732,018

$$\frac{337,546,182 - 336,732,018}{337,546,182} = 0.2\% \text{ difference.}$$

In order to make the test complete and the results more conclusive an analysis of the gas was standard cubic foot was computed from this analysis. Although the actual composition of the gas was found to be considerably different from that assumed for the design of the meter, the values of specific heat as computed from the two analyses are almost identical.

After the tests were computed the heater and thermometer units were removed from the casing and thoroughly inspected. They were found to be in perfect condition and the only deposits to be found anywhere inside the casing were a very thin coating of fine dark brown powder, almost dry and a few finely divided pieces of scale. The recording instruments and control device were also found to be in perfect condition.

These tests have proved conclusively that the Thomas meter will give under widely varying conditions of pressure, rate of flow, etc., direct results in standard units that compare most favorably with those obtained from frequent and careful observations on Pitot tubes and the use of tables and coefficients that have been very carefully checked. The particular property of the electric meter by virtue of which it will measure gases at any pressure and temperature and give direct readings in standard units in spite of variations in pressure and temperature make it applicable to the measurements of compressed air used in the mines and other industries.

**Conditions Which Affect Accuracy.**

Since measurement by this method depends directly upon the specific heat of the gas, the accuracy of the meter will be affected by any conditions that affect the specific heat. The specific heat of a gas may be affected by the presence of water vapor, by a change in the proportions of its constituents, or by a change in the proportions of a mixture of two kinds of gases. That it is not affected by changes in temperature or pressure within working limits is not only in accordance with established theory but it has been proved in the tests with natural gas already described.

Air and most gases which need to be measured contain water vapor in varying amounts. As the amount of vapor that a gas will hold at any temperature and pressure is independent of the kind of gas, air may be taken as a typical case. At 60 degrees F. and at atmospheric pressure air will hold, if it is fully saturated, 5.6 grains of water vapor per cubic foot. The weight of the mixture of air and vapor is about 533 grains. Then the water might amount to about 1.05 per cent of the weight of the air. As the specific heat of water vapor is approximately twice that of air the maximum error that could occur due to the presence of the water vapor would be

| Date | $CO_2$ | $C_n H_{2n}$ | $O_2$ | CO | $H_2$ | $CH_4$ | $N_2$ | CP | BTU | Sp. Gr. | Sp. Ht. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| June | | | | | | | | | | | |
| 11 | 3.4 | 9.2 | 0.4 | 11.0 | 37.2 | 32.9 | 5.9 | 21.8 | 703 | .518 | 0.2168 |
| 12 | 3.5 | 9.7 | 0.4 | 9.8 | 36.6 | 33.2 | 6.8 | 22.9 | 710 | .522 | .02174 |
| 14 | 3.4 | 10.2 | 0.4 | 10.0 | 36.3 | 33.6 | 6.1 | 22.9 | 724 | .523 | .02182 |
| 15 | 4.0 | 10.0 | 0.4 | 10.6 | 35.8 | 32.5 | 6.7 | 21.4 | 708 | .535 | .02180 |
| 16 | 3.5 | 9.3 | 0.4 | 10.2 | 38.3 | 31.9 | 6.4 | 21.6 | 696 | .512 | .02167 |
| 17 | 3.4 | 9.6 | 0.2 | 10.0 | 36.7 | 34.6 | 5.5 | 20.9 | 724 | .515 | .02182 |
| 18 | 3.6 | 10.0 | 0.4 | 10.0 | 37.2 | 32.3 | 6.5 | 21.5 | 709 | .521 | .02173 |
| 19 | 4.0 | 9.6 | 0.2 | 10.6 | 34.5 | 34.0 | 7.1 | 22.1 | 712 | .540 | .02182 |
| 21 | 3.8 | 9.7 | 0.2 | 10.0 | 35.6 | 33.7 | 7.0 | 21.7 | 712 | .531 | .02182 |
| 22 | 3.7 | 9.7 | 0.4 | 10.2 | 37.2 | 32.9 | 5.9 | 22.0 | 710 | .519 | .02174 |
| Avg. | 3.63 | 9.70 | 0.34 | 10.24 | 36.54 | 33.16 | 6.39 | 21.88 | 710.7 | .5236 | .02176 |

Mean of ten values of specific heat computed from individual analyses, .02176.

Maximum variation of specific heat computed for individual analyses from the specific heat computed fro the average analyses, 0.4%.

about 1 per cent. Since the humidity of air is seldom lower than 50 per cent the variation in its specific heat would be much less than 1 per cent. Should it be desirable to make corrections for this small error they can be made from the tables for saturated gases on the basis of an assumed or an ascertained humidity. If the gas to be measured is over saturated, and water is carried along mechanically as a fog or mist, the evaporation of this by the heater energy of course interferes with making accurate measurements. This difficulty can be easily overcome by heating the gas slightly above the temperature of saturation before it enters the meter.

The variations in composition of gases which we need most to consider in relation to their effect upon the specific heat are those which occur in the mixtures of two different kinds of gases. The following table, copied from a paper by Mr. E. C. Jones in the Proceedings of the American Gas Institute for 1909, shows the variation in composition from day to day of mixed crude oil gas and carburetted water gas. To this table have been added the computed values of specific heat in B.t.u. per pound per degree F. for a cubic foot of gas at 14.696 pounds absolute pressure and 60 degrees F.

This table indicates that the results obtained from a meter designed on the basis of the average analysis would be subject to a maximum error during any day of a small fraction of one per cent and that this error will be averaged out in longer periods of time.

From the table given below showing the computed values of specific heat for different mixtures of coal and water gas it is seen that the effect upon the specific heat of the variations in the mixtures of these gases that occur under working conditions is negligible.

| Water Gas. | Coal Gas | Specific Heat. |
|---|---|---|
| 100% | 0% | .02094 |
| 90 | 10 | .02096 |
| 80 | 20 | .02098 |
| 70 | 30 | .02100 |
| 60 | 40 | .02102 |
| 50 | 50 | .02104 |
| 40 | 60 | .02106 |
| 30 | 70 | .02110 |
| 20 | 80 | .02110 |
| 10 | 90 | .02112 |
| 0 | 100 | .02114 |

These values of specific heat are in B.t.u. per degree F. for a cubic foot of gas at 14,804 pounds absolute pressure and 60 degrees F. They are based upon the following two typical analyses for water gas and coal gas in a city plant..

| | Water Gas. | Coal Gas. |
|---|---|---|
| $Co_2$ | 3.8 | 3.2 |
| $C_nH_{2n}$ | 12.3 | 3.3 |
| O | 0.6 | 0.5 |
| CO | 30.4 | 6.9 |
| H | 33.3 | 50.6 |
| $CH_4$ | 14.4 | 34.2 |
| N | 5.2 | 2.3 |

Where a meter is an important feature of a gas distribution system it is periodically inspected and it is very desirable to be able to ascertain whether the parts inside the gas main are in proper condition. Since the electric meter has no moving parts inside the gas main the only effects which the action of the gas can have on the inner parts are those due to deposits or corrosive actions on the heater and thermometer units. Since the watts dissipated in the heater, as measured by the wattmeter, are a product of current flowing through the heater and voltage across its terminals, their measurement is independent of the resistance or surface of the heater unit itself and therefore cannot be affected by either corrosion or deposits. Should excessive deposits occur on the units they would only tend to make them slower in following sudden changes in flow. Provision is made for checking the condition of the thermometers from the recording panel without removing the cover from the meter casing. With gas flowing through the meter the heater current is broken and the temperature resistance in series with the $T_1$ thermometer is shorted out. If the thermometers are in proper condition the galvanometer needle will come to a balance. If the thermometer circuits do not thus balance a small rheostat is provided in the galvanometer box to bring them back to a proper balance. Thus the only parts of the meter which can be affected to cause inaccuracies of measurement can be checked up from the recording panel as often as desired.

The heater and thermometer resistances are evenly distributed over the total section of the gas passage so that all of the gas is heated and a correct average temperature difference is obtained regardless of variations in velocity at different parts of the section. On this account it is possible to obtain accurate results without providing a long length of straight pipe in the approach to the meter. This was proved in the natural gas tests already described in which the meter was located directly between two risers from an underground line and very close to several bends. On account of the slight heat capacity of the heater and thermometer units they will not change their temperatures instantly and therefore quick pulsations in the rate of flow are averaged out and do not show up in the record. The integrating wattmeter also correctly integrates periodical fluctuations in the rate of flow.

**Working Range and Flexibility of Parts.**

The working range between maximum and minimum rates of flow at which the electric meter will measure accurately is about 14 to 1. By changing the temperature range through which the gas is heated, which is accomplished by shifting a resistance plug at the recording panel, the meter will measure accurately down to a minimum rate of about one and one-half per cent of the maximum. This wide working range combined with the ability to make an accurate continuous graphical record of the rate of flow makes possible investigations of the shape and magnitude of peak loads and other irregularities in flow.

As shown by Figs. 2, 3 and 5 the arrangement of parts of the meter is very flexible. The meter casing may be in either a horizontal or a vertical position and the recording panel can be located at almost any desired distance from the meter, since the connections between them are all electrical and therefore perfectly flexible. In meters of very large capacity where the rheostat becomes quite large the recording instruments and control switches may be put on a separate panel and the rheostat put in any convenient location. It will also be noted that the design lends itself very easily to a remote control from gate valves, etc., in the gas main.

## ELECTRICAL APPLIANCES FOR WESTERN CANADA.

Within a few months the city of Winnipeg will be prepared to sell electrical energy. Its great plant at Point du Bois, costing $2,250,000, and capable of generating 100,000 horsepower, is rapidly nearing completion; and the business men of Winnipeg, as well as householders generally, are looking forward with keen anticipation to cheaper power. While the city is contemplating purchasing the street car system, it may develop during negotiations that it will take over the power plant of the street railway company, which supplies not only power for the railway, but also furnishes electricity for private lighting, as well as for commercial power.

The rates for power at present are as follows: 6 cents per watt-hour up to 50 horsepower; 4 cents per watt-hour over 50 to 100 horsepower; 3 cents per watt-hour over 100 horsepower. Private lighting costs 10 cents per kilowatt; electricity for cooking costs 6 cents; gas, $1.20 per 1,000 feet.

Public lighting, which is done by tne city electric-lighting plant, costs an average of 11 cents per arc lamp per night, the total cost in 1910 being $42,977.

## USE OF HERTZIAN WAVES AS FOG SIGNALS.

As far back as 1908, at the Eighth International Navigation Congress held in Paris, the Lighthouse Department of France has had in mind the employment of Hertzian waves for the production of fog signals.

The Minister of Public Works has now decided that the time is a fitting one to proceed with the installation of suitably chosen Hertzian posts, which may be increased as they are needed and as improvements are made.

The characteristics of the three new signals will be as follows:

Creach d'Ouessant lighthouse: A fog signal with the regular emission every 30 seconds of signals producing in the telephone the note "ut 4" (522 double vibrations per second), and arranged so as to repeat, at least during 10 seconds, slowly, the letter "o" of the Morse alphabet.

Ile de Sein lighthouse: A fog signal with the regular emission every 30 seconds of signals producing in the telephone the note "sol 4" (783 double vibrations per second), and arranged to repeat slowly, during at least 10 seconds, the letter "s" of the Morse alphabet.

On board the lightship Le Havre (in constructions): A fog signal giving ,with a wave length of 80 meters (262 ft.) the regular emission every 30 seconds of signals producing in the telephone the note "ut 4," and arranged so as to repeat slowly, during 10 seconds at least, the letter "h" of the Morse alphabet.

## PHILIPPINE ELECTRIC LINE.

The long-looked-for and much-desired Manila street railway extension to the new docks will be realized in a short time, according to a statement made by General Manager Graves, who announces thas his company is ready to begin the extension work, which will be undertaken as soon as the Government gives its consent.

## ELECTRICAL MACHINERY AND APPARATUS.[1]

The electrical industries have had a most remarkable development during the past decade. The value of the machinery and apparatus manufactured for use in the generation and utilization of electricity increased from $105,832,000 in 1899 to $159,551,000 in 1904, and $243,967,000 in 1909, or 130 per cent during the decade. Large quantities of supplies used for electrical purposes are manufactured in foundry and machine shops and other establishments not identified with the electrical industries. These parts are assembled by dealers and others not covered by the census, and it is impossible to obtain accurate information in regard to them. Therefore, the totals given above are less than the true value of all of the machinery of this character manufactured annually in the United States.

The value of products represents their selling value or price at the plants as actually turned out by the factories during the census year, and does not necessarily have any relation to the amount of sales for that year.

### Dynamos.

Dynamos, dynamotors, motor generators, and similar machines constitute the most important generic group of electrical machinery. The number of dynamos manufactured annually increased from 10.527 in 1899 to 15,080 in 1904, and 16,791 in 1909, an increase of 59 per cent for the decade. The value of the dynamos for each year was $10,473,000, $11,084,000, and $13,081,000, respectively. As a rule much larger and more powerful dynamos were manufactured in 1909 than for the prior years, so that while the average value of machines manufactued was greater in 1909, they represented a lower cost for corresponding capacity. The average capacity per machines, increased from 55 kilowatts in 1889 to 66 in 1904, and 84 in 1909. The value of the dynamotors, motor generators, boosters, rotary converters ,and double currrent generators manufactured increased fom $380,000 in 1899 to $3,155,000 in 1909, or 730 per cent.

### Transformers and Switchboards.

The value of transformers manufactured increased from $2,963,000 in 1899 to $4,469,000 in 1904, or 51 per cent, and to $8,801,000 in 1909, or 197 per cent. The value of the switchboards, panel boards, cut-out cabinets for light and power increased from $1,847,000 in 1899 to $3,766,000 in 1904, or 104 per cent, and to $5,972,000 in 1909, or 223 per cent.

### Motors.

The total value of motors of all kinds, including supplies and parts, manufactured increased from $19,505,000 in 1899 to $22,371,000 in 1904, and $32,087,000 in 1909, or 64 per cent for the decade.

The number of power motors manufactured annually increased from 35,604, valued at $7,551,000, in 1899 to 79,877, valued at $13,121,000, in 1904, and to 244,123, valued at $18,306,000 in 1909, there being an increase of 586 per cent in number and 142 per cent in value for the decade. Many powerful motors were manufactured, but the number of small motors has increased so rapidly that the average capacity per machine has declined, the average horsepower per motor

[1]Preliminary Report for 1909, issued by the Census Bureau

for the three census years being 14.5, 8.5, and 6.7, respectively.

**Tabular Summary.**

The following statement summarizes the statistics for the principal products as reported at the censuses of 1909, 1904, and 1899:

In 1899 there was great activity in the manufacture of motors for automobiles, but the increase in this branch of industry has not kept pace with that for other classes of electrical equipment. The number manufactured decreased from 3,017 in 1899 to 1,879 in 1904, with an increase to 2,796 in 1909. On the other hand, the capacity of motors reported increased 4,251 horsepower, or 52 per cent, during the decade, and the value of these motors has increased from $192,000 in 1899 to $153,000 in 1904, but increased to $294,000 in 1909.

The number of small motors for the operation of fans has increased very rapidly. There were 97,577 such motors reported in 1899. In 1904 there were 102,535, and in 1909, 199,113, an increase of 104 per cent for the decade. The value of these motors increased from $1,055,000 in 1899 to $2,451,000 in 1909, or 132 per cent.

The statistics of motors for electric railroad cars cannot be shown separately without disclosing the products of individual establishments, but there was a considerable increase in the manufacture of such motors as compared with the production of 1904, which was 12,298, of 713,181 horsepower, valued at $4,950,000. Considering the group of motors for cars, elevators, and similar purposes, the combined number decreased from 23,582 in 1899 to 22,112 in 1904, and increased to 58,698 in 1909. The value of these motors was $10,707,000 in 1899, $7,929,000 in 1904, and $11,036,000 in 1909, there being an increase of 149 per cent in number and 3 per cent in value during the decade, the decrease shown for the group in 1904 being entirely due to the decrease in the manufacture of railway motors at that census.

**Storage and Primary Batteries.**

The value of the storage and primary batteries manufactured increased from $3,679,000 in 1899 to $4,244,000 in 1904 and $10,612,000 in 1909, or 188 per cent during the decade. Both storage and primary batteries consist of various elements which are not always combined and sold together as a unit by the same manufacturers, and yet it is not until these are brought together that a complete cell is constituted. Many of the parts and supplies used are manufactured outside of the electrical field, and therefore the statistics shown in this report do not convey a correct idea of the importance of this branch of the industry.

**Arc and Incandenscent Lamps.**

The number of arc lamps manufactured increased from 158,187 in 1899 to 195,157 in 1904, and decreased to 123,543 in 1909. The decrease is accounted for by the fact that other varieties of lamps are now used for street light and for other purposes for which arc lamps were formerly used almost exclusively. The value of these lamps deceased slightly in 1904 ($1,574,000) as compared with 1899 ($1,828,000), but owing to the introduction of more types of these lamps, such as flaming arcs, increased to $1,707,000 in 1909.

The group of incandescent lamps includes carbon filament, gem, tantalum, tungsten, glower vacuum, vapor and similar lamps used for lighting, advertising and decorative purposes. Some of these varieties were not manufactured in 1899 or 1904. A large number of decorative and miniature lamps, X-ray bulbs, vacuum tubes, etc., are now manufactured, but the varieties are so numerous that it is impossible to obtain accurate statistics of the number. The total value of the group increased from $3,515,000 in 1899 to $6,953,000 in 1904 and $15,715,000 in 1909. The value of the carbon filament lamps increased rapidly from 1899 to 1904, but there was a slight decrease in 1909, the value for the respective years being $3,442,000, $6,308,000, and $6,157,000. The manufacture of gem, tantalum, tungsten, and other metal filament lamps was reported separately for the first time at the census of 1909, when they were valued at $7,682,000. Some of these new variaties of lamps were not reported separately at prior censuses, and it is possible that they were included with the carbon filament lamps, thus accounting in part for the apparent decrease in that variety of lamp. Advertising, decorative, and all other lamps, including in 1909 glower lamps, vacuum and vapor lamps not separately reported in 1904, have increased in value from $645,000 in 1904 to $1,876,000 in 1909.

The total value of all lamps reported for 1909 was $15,715,000. This does not include sockets, receptacles, bases, etc., or lighting fixtures of any character.

**Lighting Fixtures.**

The value of electric-light fixtures of all kinds manufactured in 1899 was $3,751,000; in 1904, $3,295,000; and in 1909, $6,128,000. Large quantities of combination gas and electric fixtures are now manufactured. At the census of 1909 it was ascertained that the value of these combination fixtures was about $12,884,000. Their value for prior censuses cannot be ascertained, and there were undoubtedly large quantities manufactured in connection with the manufacture of gas fixtures which are not identified with the manufacture of electric supplies, and their value is not included in this report.

**Telegraph and Telephone Instruments.**

The telegraph instruments include intelligence (key, sounder, etc.) of all kinds, police, fire, district, and miscellaneous instruments, wireless apparatus, also switchboards and telegraph parts and supplies. The total of this group of instruments in 1899 amounted to $1,642,000, in 1904 to $1,111,000, and in 1909, $1,957,000, an increase of 19 per cent in the decade.

Telephone apparatus includes transmitters, receivers, complete sets of instruments (not included in the separate parts), interior telephone systems complete, and central switchboards, private exchange boards, parts and supplies. The total value of this group in 1889 was $10,512,000 as compared with $15,864,000 in 1904, and $15,547,000 in 1909, a slight decrease during the last five-year period.

The report also shows the value of the total annual output of miscellaneous apparatus used in connection

with the utilization of electric current. Principal among these may be mentioned electric measuring instruments, the output for which in 1909 was $7,800,000; magneto-ignition apparatus, sparks, coils, etc., valued at $6,080,000; electric switches, signals and attachments, $5,384,000; heating, cooking, and welding apparatus, $1,003,000; lightning arresters, fuses, etc., valued at $1,942,000; theraputic apparatus, $1,116,000; circuit fittings, $1,081 000; and electric flatirons, $951,000.

ELECTRICAL MACHINERY, APPARATUS AND SUPPLIES—PRODUCTS, BY KIND, QUANTITY, AND VALUE: 1909, 1904, AND 1899.

| ITEMS. | 1909 | 1904 | 1899 |
|---|---|---|---|
| Number of establishments | [1] 1,255 | [1] 912 | [1] 581 |
| Total value of products | $243,997,000 | $159,851,000 | $105,833,000 |
| Dynamos: | | | |
| Number | 18,791 | 15,080 | 10,527 |
| Total kilowatts | 1,406,061 | 996,182 | 575,124 |
| Value | $15,081,000 | $11,084,000 | $10,473,000 |
| Dynamotors, motor generators, boosters, rotary converters and double-current generators | $3,155,000 | $1,740,000 | $380,000 |
| Transformers for light and power | 35,801,000 | 24,409,000 | $2,965,000 |
| Switchboards, panel boards, cut-out cabinets for light and power | $5,973,000 | $3,766,000 | $1,847,000 |
| Motors: | | | |
| For power— | | | |
| Number | 244,123 | 79,877 | 25,804 |
| Horsepower | 1,623,677 | 678,916 | 515,705 |
| Value | $18,306,000 | $13,121,000 | $7,651,000 |
| For automobiles— | | | |
| Number | 2,796 | 1,819 | 3,017 |
| Horsepower | 12,471 | 10,927 | 8,220 |
| Value | $394,000 | $153,000 | $192,000 |
| For fans— | | | |
| Number | 199,113 | 102,535 | 97,577 |
| Horsepower | 178,033 | 30,796 | 12,796 |
| Value | $2,451,000 | $1,165,000 | $1,055,000 |
| For railways, elevators, and miscellaneous services, including supplies and parts— | | | |
| Number | 58,698 | 23,112 | 23,582 |
| Horsepower | 859,237 | 763,399 | 684,761 |
| Value | $11,030,000 | $7,929,000 | $10,707,000 |
| Storage batteries, including parts and supplies: | | | |
| Weight of plates in pounds | 23,119,331 | 16,113,073 | (2) |
| Value | $4,678,000 | $2,646,000 | $3,560,000 |
| Primary batteries including parts and supplies: | | | |
| Number | 34,333,531 | 6,623,162 | 2,654,765 |
| Value | $5,934,000 | $1,598,000 | $1,119,000 |
| Arc lamps: | | | |
| Number | 123,543 | 195,157 | 158,187 |
| Value | $1,707,000 | $1,574,000 | $1,828,000 |
| Searchlights, projectors, and focusing lamps | $838,000 | $115,000 | $226,000 |
| Incandescent lamps: | | | |
| Carbon filament, gem, tantalum, tungsten lamps | $13,339,000 | $6,308,000 | $3,442,000 |
| Decorative and miniature lamps, X-ray bulbs, vacuum tubes, etc. (also includes glower lamps and parts, and vacuum and vapor lamps) | $1,876,000 | $645,000 | $73,000 |
| Sockets, receptacles, bases, etc | $4,322,000 | $2,011,000 | $894,000 |
| Electric lighting fixtures of all kinds | $6,128,000 | $3,295,000 | $3,751,000 |
| Telegraph apparatus | $1,967,000 | $1,111,000 | $1,642,000 |
| Telephone apparatus | $15,547,000 | $15,804,000 | $10,512,000 |
| Insulated wires and cables | $35,578,000 | $24,520,000 | $21,202,000 |
| Electric conduits | $3,098,000 | $2,416,000 | $1,098,000 |
| Annunciators—Domestic, hotel, and office | $236,000 | $186,000 | $225,000 |
| Electric clocks and time mechanisms | $392,000 | $374,000 | $432,000 |
| Fuses | $1,002,000 | $695,000 | $526,000 |
| Lightning arresters | $940,000 | $587,000 | |
| Rheostats and resistances | $2,675,000 | $933,000 | $1,137,000 |
| Heating, cooking, and welding apparatus | $1,003,000 | $396,000 | |
| Electric flatirons | $951,000 | (2) | (2) |
| Electric measuring instruments | $7,800,000 | $5,005,000 | $1,842,000 |
| Electrical therapeutic apparatus | $1,116,000 | $1,037,000 | (2) |
| Magneto-ignition apparatus, sparks, coils, etc | $6,080,000 | $878,000 | (2) |
| Electric switches, signals, and attachments | $5,384,000 | $1,451,000 | $1,120,000 |
| Circuit fittings of all kinds | $1,081,000 | $3,325,000 | (2) |
| All other products | $34,000,000 | $26,179,000 | $15,384,000 |
| Amount received from custom work and repairing | $5,691,000 | $2,799,000 | $2,064,000 |

[1] Includes establishments engaged primarily in the manufacture of products not identified with the electric industries, but incidentally making electrical machinery, apparatus, and supplies, as follows:

| Year. | Number of establishments. | Value of product reported. |
|---|---|---|
| 1909 | 346 | $22,600,000 |
| 1904 | 128 | 18,762,000 |
| 1899 | | 13,397,000 |

[2] Not separately reported.

## DEMONSTRATIONS OF THE UNITED STATES BUREAU OF MINES.

At the Arsenal Grounds, 40th and Butler streets, beginning at 9:00 a. m., October 30, 1911, and closing at 12 m. a demonstration of the work of the Bureau of Mines, with exhibit of detonation of permissible and other explosives, in the steel lined gallery, filled with dust and gas.

Exhibits and tests of mine safety lamps in lamp gallery; of electric sparks in gallery No. 2 in the presence of inflammable mixture of air and gas; of training in rescue work with oxygen helmets; of investigations and tests of explosives.

## PRIMER OF APPLIED THERMODYNAMICS.[1] THIRD LECTURE.

### Fuels and Their Calorific Value.

In the study of Thermodynamics, should we adhere strictly to our subject, we should deal largely in the abstract in our consideration of heat forces. We shall find, however, that if we can keep before our mental vision a concrete idea of heat and some of the factors used in producing heat, it will materially aid us in getting a thorough grasp of the applications of Thermodynamics.

In engineering practice the process used to manufacture or supply heat is known as combustion. In order to bring about combustion, certain substances called fuels are heated to a relatively high temperature, and then when air passes over and through the heated fuels the oxygen of the air chemically combines with certain ingredients of the fuels used and large quantities of heat are given out. These quantities of heat in turn are corralled, as far as possible, by the mechanical devices which go to make up the boiler and are used to heat water, evaporating the same into steam, which, in turn, is used to perform useful work in the industries.

Among the so-called solid fuels may be mentioned wood, peat, bituminous and anthracite coal, charcoal, coke, and oftentimes various waste products, such as sawdust, bagasse, straw, and spent tan. The liquid fuels comprise crude petroleum and various tarry residues, while the gaseous fuels are composed of natural gas, producer, blast-furnace, water, and illuminating gas. The essential constituents in all fuels are carbon and hydrogen; the accessory, oxygen, nitrogen, and ash; and the bad qualities, water, sulphur, and phosphorus.

In order to fix our ideas relative to the good and bad qualities to be sought after in fuels, we shall now devote considerable attention to the discussion of crude petroleum, which, above all others, due to its practically unlimited supply, is the most useful fuel on the Pacific Coast.

Attention was first drawn to the presence of petroleum in California by the discovery of numerous oil seepages, in Los Angeles, Ventura, Santa Barbara, and adjacent counties. The recorded production in 1875 was but 3000 barrels, while, in the year 1910. the total reached the enormous figure of 77,000,000,000 barrels. Fig. 9 shows graphically the growth of this great industry in California. The United States Geological Survey, in 1908, reported 8450 square miles of possible oil territory in the United States, giving California 850 square miles, or about one-tenth of the total area, but they give her credit for one-half of the probable minimum oil production of the United States, or one-third of the probable maximum production as follows:

| | Minimum | Maximum |
|---|---|---|
| California oil fields | 5,000,000,000 | 8,500,000,000 |
| All other U. S. fields | 5,000,000,000 | 16,000,000,000 |
| Total | 10,000,000,000 | 24,500,000,000 |

A. F. L. Bell, in a paper before the San Francisco section of the A. S. M. E., has estimated that, taking the present production of 75,000,000, barrels as

[1] A resume, devoid of higher mathematics, covering the essentials of a series of lectures now being given by the editor of this Journal before the Senior Mechanical Engineering students at the University of California.

the maximum consumption, we have ahead 52½ years' supply in proven territory, and for proven and prospective territory, about 230 years' supply.

Crude petroleum consists principally of various combinations of hydrogen and carbon, together with comparatively small amounts of nitrogen, oxygen, and sulphur. Taking hydrogen and carbon as the

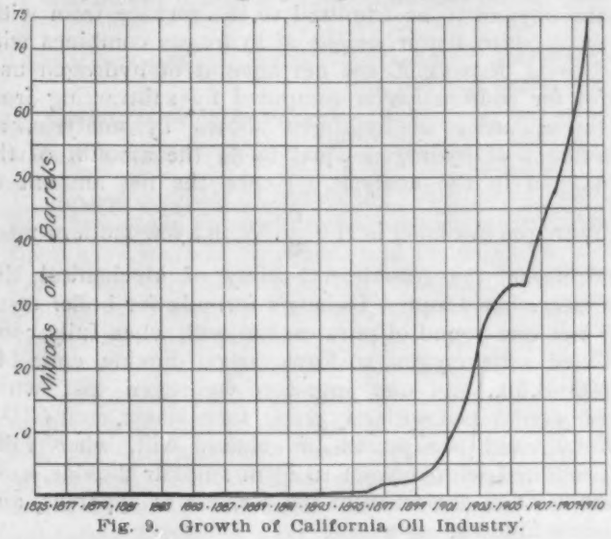


Fig. 9. Growth of California Oil Industry.

principal constituents, it is found that those oils which are rich in the former element are of light specific gravity as compared with those rich in carbon. The range in specific gravity of California oils may be taken as from unity to 0.84, or from 10 to 36 of the Baume scale. The majority of the fuel oils will range from unity to 0.9 or from 10 to 23 Baume.

Professor Joseph Le Conte of the University of California, by plotting a large number of calorific values of oils as shown in Fig. 10, derived an approximate relationship between heating value and specific gravity of oils, which can be found from the curve shown in the figure.

The Baume scale bears the following relationship with specific gravity:

$$\text{Sp. Gr.} = \frac{140}{130 + \text{B}} \quad \text{or} \quad \text{B} = \frac{140}{\text{Sp. gr.}} - 130$$

From the curve thus plotted Mr. Le Conte has deduced the following empiracal law for heating value of California crude petroleum:

$$\text{B.t.u. per lb. of oil} = 17680 + 60\,\text{B}$$

where B is the reading on the Baume scale.

In order that petroleum may be burned with complete combustion, it is necessary that it be either gasified or injected in the form of spray into the furnace in which it is burned. Some forms of pan burners have been devised for use in hot air furnaces, where oil drips into the pan and burns from the surface, but they are of no importance in power or industrial work. A. M. Hunt, in a paper on the atomization of oil fuel read before the San Francisco Section of the A. S. M. E., has gone into this subject thoroughly, and his ideas are largely followed in the description of this process. In the first place, the general practice is to deliver the oil to the burner under pressure, and inject or pulverize it, using steam or air as the pulverizing medium. The oil so injected into the furnace should be entirely gasified or burned, while it is in suspension in the air; otherwise, if particles of unconsumed oil fall to the bottom of the furnace, coke will be formed, which gradually accumulates and builds up. Hence, if the furnace is short, the oil particles will have relatively short time period within which they must be consumed, and must, therefore, be smaller.

Hundreds of burners have been invented, and great claims have been made by each inventor as to the possible saving to be effected with his particular form. The burner, however, is really an item of minor importance in all oil burning installation, as compared with furnace construction, proper air admission, and other points.

Regarding the amount of steam necessary for atomization, various tests range from 0.2 to 0.6 lb. of steam per lb. of oil consumed, C. R. Weymouth, of Chas. C. Moore & Co., who has had wide experience in oil burning, states that 0.3 lb. per lb. of oil consumed is a reasonable figure to allow.

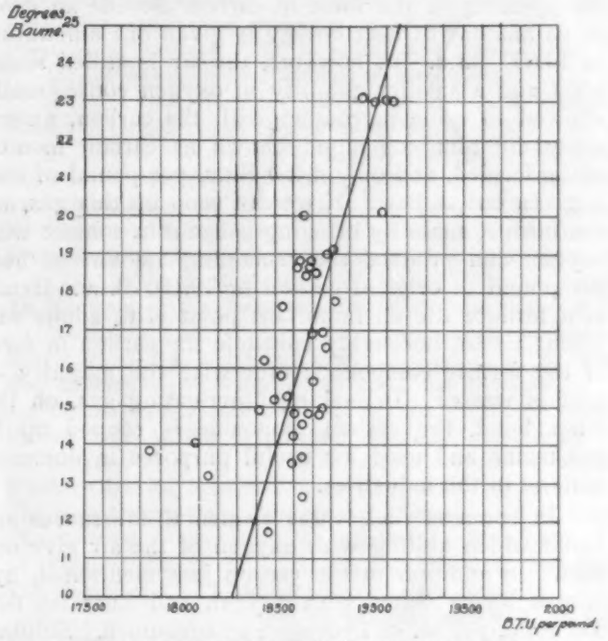


Fig. 10. Le Conte's Calorific Curve for Oils.

An excellent type of furnace used in oil burning is the so-called Peabody furnace. In this furnace the bridge wall is set back from the boiler front to give depth of from eight to ten feet, depending on the size of the boilers. The burner is of the back-shot type, inserted from the boiler front, under the floor of the furnace, turning up at the bridge wall. It shoots the flame forward toward the front of the boiler, so that this wall should have an extra course of fire-brick set in place without fire clay. At its front end, except in special boilers, the furnace should have a height of not less than six feet, and for large size boilers the height should be from seven to eight feet, depending on the character of the feed water and the desired overload.

### Calorific Value of Fuels.

In our last lecture attention was called to the three methods used in engineering practice to deter-

mine the heating value of fuels, one of which methods was that arrived at by chemical analysis.

Before going into the subject matter at hand, it will first be necessary to get a clear conception of what in reality is taking place when we say a fuel "burns." In chemistry we learn that all matter composing our physical world is made up of about eigthy substances called "elements."

These elements under certain conditions group themselves into the thousands of substances known in our everyday experience. At times they are grouped together simply as a physical mixture, but at others by absorbing or giving out heat, they form new compounds entirely unrecognizable in any of the original elements. This change is to be distinguished from the change in physical state when a body absorbs heat in passing from the solid to liquid or liquid to gaseous state, and is called a chemical reaction. Thus, when one of these elemental substances known as carbon is heated and another elemental substance known as oxygen brought in contact, carbon dioxide is formed, and for every pound of carbon disappearing in the form of carbon dioxide an enormous amount of heat energy is given out amounting to 14,600 B.t.u. If, however, the air is stifled somewhat and a smaller quantity of oxygen consequently allowed to come in contact with the carbon, an entirely different compound known as carbon monoxide is formed, and only 4,450 B.t.u. per pound of coal is given out as heat. If we can coop up this gas, we can burn it again by bringing it again in contact with oxygen and produce the remaining amount of heat per pound of original carbon or 10,150 B.t.u. Hence in a furnace the all important point is to admit sufficient air to thoroughly consume the carbon in form of the former compound; otherwise the majority of heat is wasted. In making illuminating gas, on the other hand, the carbon monoxide is cooped up in gas mains and used for useful purposes in domestic life and in the industries.

In common fuels three elemental substances are found which uniting with oxygen of the air give out heat. In addition to the carbon just mentioned, hydrogen forms water with oxygen and liberates 62,000 B.t.u. per lb. of hydrogen so consumed. Sulphur similarly forms sulphur dioxide and liberates 4000 B.t.u. per lb. of sulphur. As sulphur forms but a small percentage in common fuels and as it has a tendency to corrode the tubes of boilers, its presence is usually considered a detriment rather than a benefit.

In the study of combustion, we find certain inert gases and compounds which it is necessary to consider. For instance, the air is composed of 1 part by weight of oxygen and 4 parts of nitrogen, another elemental substance. This nitrogen performs no useful purpose, but, on the other hand, must be heated to the temperature of the flue or chimney gases, and, as a consequence, is an actual detriment by its presence. In the same manner there is an enormous loss of heat due to moisture in the fuels. The water formed by the hydrogen and oxygen which must be evaporated and then superheated to the temperature of the escaping chimney gases.

Having determined by many careful tests the heat value of individual units of carbon, hydrogen, and sulphur, as stated above, Dulong, years ago, gave forth a formula by which the calorific value of fuel can easily be computed. As the oxygen in the fuel is undoubtedly united with its combining weight of hydrogen, it is first necessary to obtain the net amount of hydrogen available for combustion with the oxygen to be admitted to the furnace from without. Since 1 unit weight of hydrogen combines with 8 units of oxygen, the net amount of hydrogen useful for combustion is computed by subtracting from the quantity of hydrogen shown by analysis, an amount of hydrogen equal to ⅛ the amount of the oxygen in the analysis. Hence the net amount of hydrogen available is $H - \frac{O}{8}$. With a few modern modifications, the American Society of Mechanical Engineers has adopted Dulong's formula for boiler tests. Since one pound of pure carbon will, when fully combined with oxygen, to form carbon dioxide, emit 14,600 B.t.u., and one pound of hydrogen will, when fully combined with oxygen to form water, emit 62,000 B.t.u., and one pound of sulphur will, when fully combined with oxygen to form sulphur dioxide, emit 4000 B.t.u., the truth of the formula is apparent, and is as follows:

$$\text{Heating value of fuel per lb.} = 14{,}600\ C + 62{,}000\left(H - \frac{O}{8}\right) + 4{,}000\ S$$

where C, H, O, and S are the proportions by weight of carbon, hydrogen, oxygen, and sulphur found to be in the fuel by chemical analysis.

Now it is evident that in a boiler all of this heat per pound of coal or fuel cannot be put to a useful purpose, because the nitrogen of the air which has been admitted to the furnace has not been consumed. In fact energy must actually be wasted upon it, for it must be heated to the temperature of the escaping gases. The water or moisture in the fuel, as well as the water formed by the oxygen in the fuel, must be evaporated and the steam superheated to the temperature of the departing chimney gases. Many other wastes of heat occur, but these we can compute with a reasonable degree of accuracy by the formula

$$\text{B.t.u. lost} = (9\,H + W)\,[\,212.9 - t + 965.8 + 0.48\,(t_e - 212)\,] + 0.243\,(t_e - t)\,N. + .21\,(t_e - t)\,CO_2$$

in which H, W, N and $CO_2$ are the proportional content of hydrogen, water, nitrogen and carbon dioxide $t_e$ the temperature of the chimney gases, and t the temperature of the air admitted to the furnace.

It will be interesting, and at the same time exceedingly instructive, if we apply the two above written formulas to both coal and oil fuels. Let us take as an example tests of coal and oil as given by C. E. Wieland before the San Francisco Section of the A. S. M. E. in December, 1910, and printed in the Journal of March 18, 1911.

PROXIMATE ANALYSIS.

| | Pocahontas Coal Per cent | Kern Crude Oil 14.5 Gravity Per cent |
|---|---|---|
| Fixed Carbon | 73.30 | |
| Volatile matter | 17.61 | |
| Moisture | .49 | .15 |
| Ash | 8.60 | |
| | 100.00 | |

ULTIMATE ANALYSIS.

| | | |
|---|---|---|
| Carbon | 82.26 | 87.64 |
| Hydrogen | 3.88 | 10.48 |
| Sulphur | .49 | 1.02 |
| Oxygen | 4.12 | .08 |
| Nitrogen | .64 | .78 |
| Ash | 8.60 | none |
| | 100.00 | 100.00 |

Substituting in Dulong's formula, we have for the calorific value of the coal per lb.:

$$14{,}600 \times .8226 + 62{,}000 \left(.0388 - \frac{.0412}{8}\right) + 4000 \times .0049 = 14{,}112.8$$

Calorimeter Test = 14,067.

Calorific value of the oil per lb.:

$$14{,}600 \times .8764 + 62{,}000 \left(.1048 - \frac{.0008}{8}\right) + 4000 \times .0102 = 19{,}327.6$$

Other methods of computing the calorific value of fuels have been put forth by various engineers. All of them have more or less merit and for particular cases prove not only short-cuts but exceedingly accurate. Dulong's formula, in the main, nevertheless, is to be desired above all others.

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Beginning with the next issue, due to considerable interest on the part of the readers of the Journal, the Thermotwisters will appear solved. Four weeks will be allowed to elapse, however, for each series of solved problems. In a word, the problems appearing solved in next week's issue, will be those issued in conjunction with the first lecture, and there will appear in each following issue, completely solved, the Thermotwisters published four weeks earlier.

THERMOTWISTERS.

1. California oil has a specific gravity of 0.92 and it is found to contain 5% moisture. Apply Le Conte's formula and compute the calorific value per pound of oil.

2. A sample of Pocahontas coal is found by chemical analysis to contain the following ingredients:

| | |
|---|---|
| Carbon | 84.87 |
| Hydrogen | 4.20 |
| Oxygen | 2.84 |
| Nitrogen | 0.85 |
| Sulphur | 0.59 |
| Ash | 5.89 |
| Moisture | 0.76 |
| | 100.00% |

Compute by Dulong's formula the calorific value of the coal per pound of fuel.

## SAN FRANCISCO MEETING AND JAPAN EXCURSION OF MINING ENGINEERS.

A cordial invitation is extended to all members of the American Institute of Electrical Engineers to participate in the 101st meeting of the American Institute of Mining Engineers, which will be held in San Francisco beginning Thursday, October 10, 1911. It is proposed to secure for the party making the trip West a special train de luxe, which will leave Chicago on Saturday, September 30, 1911, at 8 p.m. A day or two each will be spent at the Grand Canyon of the Colorado in Arizona, Los Angeles, Santa Barbara and Del Monte. The party will reach San Francisco on Tuesday morning, October 10. In addition to the usual sessions for the reading and discussion of technical papers, the local committee in San Francisco contemplates a number of excursions in and about the city, including the oil fields, gold dredges, Mt. Tamalpais, Lick Observatory, University of California and Stanford University.

A similar invitation is extended to Institute members to participate in a special excursion to Japan. Accommodations have been secured on the steamships Manchuria and Siberia. The party will leave San Francisco on October 17, arriving in Yokohama on November 3. It is planned to spend 18 days in Japan, leaving Yokohama on November 21, arriving in San Francisco on December 7, Chicago on December 11, 1911. The excursion in Japan will include trips to the Tokio, Nikko and Chuzenji district, Kiota, Nara, Osaka, Kobe, Ikuno, silver mine, Imperial Steel Works, etc.

The complete itinerary giving full details including rates may be obtained on application to Dr. Joseph Struthers, secretary American Institute of Mining Engineers, 29 West Thirty-ninth street, New York City. Members desiring to participate in either of these trips should communicate with Dr. Struthers at once.

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## ILLUMINATING ENGINEERING SOCIETY.

The fifth annual convention of the Illuminating Engineering Society will be held in Chicago, Sept. 25th to 28th inclusive. A most helpful and attractive series of papers is in course of preparation for this gathering and unusual interest is being shown for the coming event. The program is as follows:

Presidential Address, "The Relations of Physico-Physiological Research to Illuminating Engineering"..... .....Dr. A. E. Kennelly

Report of Committee on Nomenclature and Standards.... .....A. J. Humphries, Chairman

Report of Committee on Progress..Dr. Louis Bell, Chairman

The Manufacture of Glass from the Viewpoint of the Illuminating Engineer.....E. H. Bostock

Symposium on Illuminating Glassware....Bassett Jones, Jr., .....A. J. Marshall, L. W. Young, C. M. McCormick

An Analysis of the Requirements of Modern Reflector Design .....F. L. Godinez

Recent Small Gas Lighting Units.....F. H. Gilpin

The Production of Natural Gas from the Illuminating Engineer's Standpoint .....G. S. Barrows

Recent Developments in the Manufacture of Incandescent Lamps . . .....J. E. Randall

Flames Carrying Electric Current.....C. F. Lorenz

The New Quartz Tube Mercury Arc Lamp....Geo. C. Keech

The Law of Conservation as Applied to Illuminating Calculations .....Dr. A. S. McAllister

The Photometry of Lighting Units of High Intensity.... .....Geo. H. Stickney and S. L. E. Rose

Photometry at Low Intensities.....Dr. Louis Bell

Evaluation of Lamp Life.....P. S. Millar and L. J. Lewinson

Distribution of Luminosity in Nature.....Dr. H. E. Ives

Light Distribution—Its Influence Upon Illuminating Efficiency and Visual Acuity .....A. J. Sweet

Resume of Legislative Enactments on Illumination..... .....E. L. Elliott

Selling Illumination .....F. B. Rae

(Title to be announced later) .....J. R. Cravath

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## A TRANSPORTATION RECORD IN CULEBRA CUT.

On August 14, nine 35-car small dump trains, and twelve 27-car large dump trains were handled to Gatun; fifty-one 21-car Lidgerwood trains were handled to Chagres district dumps, making a total of 72 trains, 1,710 cars, and 57,357 cubic yards handled out of the north end of the Culebra Cut on that date, which is the largest number of trains ever handled in one day out of that end of the cut.

## ATTRACTIVE ADVERTISING.

The Southern California Edison Company has been putting out some attractive advertising in Los Angeles of late. The accompanying cut illustrates a unique campaign now being waged by the company in its efforts to incraese power consumption even in as small units as the eight candle-power lamp. The sacred shrine of the poet has evidently been invaded and its inmate made to pen his lines to assist in this remarkably energetic campaign as set forth below:

A WATCHMAN FOR SIXTY CENTS A MONTH
Do you know that at the present rates for electricity you can burn an eight candle-power porch light ten hours a night for a month for sixty cents? Telephone us for an eight candle-power lamp and protect your home against night prowlers, burglars and porch climbers.
SOUTHERN CALIFORNIA EDISON COMPANY
TELEPHONES—HOME 10821 SUNSET M. 7144

### THE PORCH-LIGHT.

*By Lawrence Greenhill*

The light-house marks the hidden rock,
Beneath the frothy foam;
The porch-light sheds its rays around,
And guards the peaceful home.
Within the circle of its light,
No sneak-thief dares invade,
Because his well illumined form,
A target bold is made.

His guilty conscience paints a fate,
That's ghastly, swift and grim—
He thinks some fellow in the house,
Will draw a bead on him.
And so he passes up the spoils,
And skulks away in dread,
Lest some one in that lighted house,
Shall pump him full of lead.
Thus prowlers shun the lighted house,
And never dare go nigh,
Where on the porch the lantern glows,
An ever watchful eye.

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In encouraging the use of the electric sign for advertising, the great power companies of the West are not only promoting a very lucrative field of power consumption, thus benefiting from it in a selfish way, but at the same time the beneficial results to the advertiser are almost incalculable. It is interesting to note the progress in the art of electric sign advertising, and from time to time in the pages of the Journal will appear some illustrations of the artistic taste used in up-to-date advertising. The progress in the art from crude signs to those of real artistic design is indeed very striking, and it behooves the power plant manager alert for new business to study the effects produced upon the general public in proportion to the time and thought given to it.

Formerly, due to the novelty of electric lighting effects, any contrivance that gave forth light could be used for effective advertising. The general public have, however, been educated up to the aesthetic side of things electrical during recent years. Hence, real merit displayed in developing this side of night signs is proving that it has no mean excuse for existence, but, on the other hand, progress demands its use.

## WATER-POWER DEVELOPMENT IN AUSTRIA-HUNGARY.

BY JOSEPH I. BRITTAIN.

At present there is considerable interest being manifested in the further development of water power in Austria-Hungary.

In Hungary and Croatia there are two large projects under consideration concerning the final development of waterpower. One of these projects was outlined by the firm of Albert Buss & Co., of Basel, Switzerland, and is now under consideration by the Hungarian Ministry of Agriculture. According to this project, it is contemplated to utilize the waterpower of the Danube on the Pressburg-Raab section.

The plan comprises the construction of a canal which will equally serve the interests of navigation and irrigation. In the cities of Pressburg, Wieselburg, and Raab are to be built three reservoir embankments, by which it will be possible to produce an electric energy exceeding 40,000 horsepower, which will be partly used for lighting those cities. Aside from this, the industrial establishments in the neighborhood can be supplied with electric power. The cost of these plants is estimated at $8,120,000.

A second project, for the accomplishment of which French capitalists are interested, concerns the final development of the existing waterpower in the town of Zengg in Croatia. After completing the building of all locks the power obtained will be 60,000 to 80,000 horsepower. This power is to be furnished to the city of Fiume and to the whole Croatian and Austrian seacoast in that neighborhood.

It is further proposed by the management of the Hungarian Government Railways that power be furnished them to obtain electric current for operating the railways from Fiume to Croatia by electricity. The cost of building and completing this plant is estimated at $14,210,000 to $16,240,000. This project has so far progressed that exhausive negotiations are already being made with those parties who might likely use electric power.

## AMERICAN RAILWAY STATISTICS.

Statistics published in the 1911 edition of the McGraw Electric Railway Manual, which has just been published, show the miles of track, cars operated and capitalization of electric railways of the country in 1910. Statistics are also included, giving the principal returns of the companies which make public the details of their financial results of operation.

According to the total returns for 1,279 companies, the aggregate number of miles of track operated in 1910 was 40,088. These companies operated 89,601 cars and had $2,380,011,921 capital stock outstanding, and $2,302,094,296 funded debt outstanding. The total capitalization outstanding was $4,682,106,217. In previous years, comparison of the returns made to this work of reference have been given within a few weeks after publication of the volume in the Electric Railway Journal, in connection with which the McGraw Electric Railway Manual is published. The returns this year, however, are published in the Manual together with a comparison with the returns compiled in previous years. The comparison shows a small increase in the operating companies, the number of which was 1,253 in 1909. The total miles of track reported in 1909 was 40,490, and the decrease that is shown is due to the differences in the classification of the figures for the two years. The elimination of duplications in the reports of underlying and controlling corporations, makes an apparent decrease in the miles of track as well as in the total number of cars operated. The aggregate number of cars operated in 1909 was 91,953, according to the returns compiled for that year. A similar reduction is shown in capital stock outstanding which amounted to $2,427,935,397 in 1909. The apparent decrease is due to the elimination, so far as could be determined, of intercorporate holdings of securities. The amount of funded debt outstanding, on the other hand, showed an increase in 1910 as compared with 1909 of $77,294,060. The net change in total capitalization outstanding in 1910 as compared with 1909, owing to the increase in funded debt, is a gain of $29,270,584. The returns published in the Electric Railway Journal in previous years have not included a compilation of authorized capital stock and funded debt, but the totals for these items have been compiled for this year. They show that the total authorized amount of stock of electric railway companies in the United States in 1910 was $3,135,443,005. The amount of authorized funded debt at the same time was $4,047,275,207, making a total authorized capitalization of $7,182,718,212. In the tables, returns are divided by the states, and by groups of states, following the practice of the corresponding compilation in previous years.

The actual number of companies for which the principal results of operation are reported, is much smaller than that for which the other returns are given. This is due in part to the fact that the total number of companies which report capitalization, track and cars embraces many underlying companies whose earnings and expenses are included in the returns of a larger operating company. The discrepancy is also due to the fact that some of the companies do not make public details of the result of their operation. The gross revenue for 620 companies as given, amounted in 1910 to $478,873,671. The gross earnings, as stated, include the returns of some companies which did not report their operating expenses and net revenue. The operating expenses of companies that furnished figures for this item aggregated $272,076,243. The net revenue as reported was $195,234,698.

A comparison may be made between the returns of this compilation and those indicated in the earnings of street and electric railway companies of 1907. The census report is made up without publicity of the returns of individual companies, so that it contains figures which are not available for publication under ordinary circumstances in connection with the names of the companies concerned. There are differences in the basis of compilation of the two reports which, however, do not destroy the interest of a rough comparison. Where the total number of companies reporting in the McGraw Electric Railway Manual showed gross earnings of $478,873,671, the census report as of 1907 showed $429,744,254. The amount of authorized capital stock increased, according to the returns, 25 per cent in the period of three years. The amount of outstanding capital stock increased in the same time 13.5 per cent. The increase in the outstanding funded debt in this period was 37.3 per cent. The increase from 1907 to 1910 in the miles of track of electric railways operated was 17.7 per cent.

## JOINT USE OF ELECTRIC LINE TO BE TRIED IN NORTH.

Following the introduction recently in the City Council of an ordinance providing for the condemnation and purchase of the Seattle, Renton and Southern Electric Railroad by the city of Seattle, President Crawford of the road has submitted a proposition to the city for the joint use of the line by the city, ownership to remain in the company. The city has voted to issue bonds for the construction of a municipal street railway from Renton to Salmon Bay, and it is proposed to make the Renton and Southern a part of the city's line.

A complete recital of the history of this struggle between the city of Seattle and the Seattle, Renton and Southern Electric Railroad appeared in the issue of the Journal of August 12. The outcome is of peculiar interest to those engaged in electric transportation on the Coast, as it marks the first of its kind in the West.

## CEMENT AS AN IRON PRESERVATIVE.

Tests are to be made by the Panama Canal Commission to determine the value of cement mortar, applied to iron plates by the "cement gun," as a preservative of iron. Twelve plates, 63-8 by 14 inches, have been coated with a 1 to 3 mortar of cement and sand, after they were cleaned to grey metal by the sand blast process. Six of these have been covered with a ½-inch coating, and the remaining six with a one-inch coat on one side, and a 1½-inch coat on the other. Three plates of each kind have been sent to Balboa, and three to Cristobal, where they will be kept immersed in salt water to test the mortar method of preventing corrosion. Two plates of each kind will be taken from the salt water bath at the end of three months, and one-half of the coating will be removed to determine the condition of the metal. The duration of the test for the balance of the plates will be determined later.

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office *ten days in advance of date of issue.* New advertisements will be accepted up to noon of Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN


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**Pacific Coast Conventions**

Philosophers tell us that man is a social being and cannot live by himself alone, but of necessity must depend largely upon his fellows for his material existence. Great physical barriers have had the utmost influence in the past in developing a tribe or nation. The Anglo-Saxon's stalwart qualities and independence of thought are doubtless due to the separation of the British Isles from the mainland by the English Channel. Thus was forced upon him self-dependence and a stronger community interest in all of his undertakings.

In our own country the great range of the Rocky Mountains forever stands as a barrier to separate the West from our older brothers in the East. The immensity of our great Western Empire has imbued those whose homes are in the West with ideas of comradeship and grasp of big undertakings in keeping with its traditions. Western frankness, openheartedness, hospitality, and optimistic, boosting spirit are felt and recognized the world over.

Those associated in a common industry in the West, separated as they are by thousands of miles from sister industries of the East, feel a peculiar inter-dependence of the one upon the other. Here are found problems to contend with hitherto unknown to human experience. A convention or getting together, then, of all those engaged in solving the peculiar problems, met with in the West, in any one industry, is of the greatest importance.

The Pacific Coast Gas Association, which convenes in annual convention in Oakland on Sept. 19, 20, 21, is now almost ready to graduate from its teens, this being its nineteenth annual gathering. The long list of helpful meetings held in the past assures its permanent success. The gas industry on the Coast is peculiarly distinct and unique. The annual gatherings with their list of helpful papers are largely responsible for the high state of efficiency maintained in this industry in the West. Aside from these helpful discussions, the very getting together does more to foster the true Western spirit than any other factor.

The other two Pacific Coast gatherings of the week—the Northwest Light and Power Association, at Spokane, and the Pacific Coast Electrical Jobbers, at Portland—are likewise deeply imbedded in the hearts of western technical men and with intense interest these proceedings will be watched by their brothers who are unable to attend.

The West is just entering upon a period of unprecedented commercial activity. Some are prone to believe that in the hurley-burley of the commercial struggle ahead, much of the old comradeship and whole-souled fellowship peculiar to our Western life may be forgotten. The social side of these Western conventions which has been so prominent in the past, lends an important and deeply felt aid in keeping alive this spirit of fellowship. Let everyone interested see to it that it shall never die.

**Electric Gas Meters**

Elsewhere in these columns will be found a detailed description and accurate test of the Thomas electric gas meter. The subject is an interesting one, first because of the application of electrical energy in the measuring of gas and again it is interesting in that by supplying a small quantity of heat to a gas and measuring the temperature difference before and after the application, or, what is practically the same principle by maintaining a constant difference of temperature and measuring the varying supply of heat necessary, an accurate meter can be devised.

From elementary Thermodynamics we learn that the weight of a given gas multiplied by its specific heat and again multiplied by its rise in temperature will give the amount of heat supplied. Now it is evident that if we can supply a constant amount of heat to a gas and that if we can measure the difference in temperature before and after the application, the quantity of gas is at once inversely proportional to this difference in temperature. This was the first principle employed by Professor Thomas in his experiments. The inverse proportion is not readily open to continuous readings, however, so that he next by means of supplying an electric current in varying amounts was able to maintain a constant difference of temperature. Consequently the amount of current supplied under these conditions is definitely proportional to the quantity of gas passing between the two points where the difference of temperature is maintained constant. Since this is true, the reading of an ordinary wattmeter will, when once calibrated, read thereafter accurate measurements of gas quantities. From the series of tests put through upon the meter as detailed in the article referred to, the comparison of this meter with standard quantitative measuring devices is very flattering to its designers.

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**Trend of the Electrical Industry**

As the awe-inspired sight-seer, for the first time climbing the rocky-lining of the great Pacific, observes the in-coming tide, thoughts present themselves which come at no other period in life's experience. A whirl-pool here casting into oblivion small pieces of float, struggling to keep above water, an eddy there taking out to sea what has recently been carried into shore, the continual swelling and heightening of the waters and their dashing against the rocks, and, above all, the loud-roaring din and turmoil of the whole, bring before his imagination more forcefully than can ever be pictured in words the struggle and onward progress of a great industry.

Elsewhere in these columns will be found a summary of statistics just compiled by the Census Bureau on Electrical Machinery and Apparatus. A careful reading of these statistics will unfold many interesting facts to the discerning eye of the student, and in these figures will be seen largely pictured, the results of the struggle and onward progress of the great electrical industry during the past decade. In them we can see how certain classes of design have struggled for an existence, but in the whirl-pool of competition with improved and more efficient apparatus have been forever cast into oblivion; other forms are being carried in the eddy out to sea, while still others, strengthened by experience gained and by the constructive imagination of their inventors, are coming into favor with the incoming tide, sweeping everything before them.

One of the most striking features is the steady increase in capacity of generating units and the steady decrease in capacity of operating units. Thus, it is shown that while much larger and more powerful generating units were manufactured in 1909 than for the prior years, although the average value of machines manufactured was greater, the machines represented a lower cost for corresponding capacity. The steady trend toward increase in generating units is shown by the fact that the average capacity was 55 kw. in 1899, 66 kw. in 1904, and increased to 84 kw. in 1909. On the other hand, indicative of the enormous swelling in power consumption we find that motor units employed increased 586 per cent, representing an increase in value of 142 per cent. The trend of the size of units employed in the motor shows itself in contrast to that of the generator, in that the individual units are growing proportionately smaller, being 14.5 h.p. in 1899, 8.5 h.p. in 1904, and 6.7 h.p. in 1909. Unquestionably the great centralization of hydroelectric units in the far-off mountains and the auxiliary steam plants in the big distribution centers have had their effect by increasing the average capacity of generators, and with this have also come the varied uses of electrical motors in the industries. The past ten years have substantially proved the efficiency of individual motors in factory operation, thus reducing the capacity per motor, though enormously increasing the total number in use.

In the hitherto unheard of increase of 223 per cent in ten years for transformers, and for dynamotors, motor generators, rotary conveters and the like, an increase of 720 per cent, the use of long distance transmission of electrical energy with the consequent popularity of alternating current indelibly shows itself.

A glance at the summary headed Arc and Incandescent Lamps is interesting and instructive. In a word the arc lamp industry shows itself practically at a standstill, while its younger but more energetic brother, the incandescent lamp, shows a total increase for ten years of nearly 350 per cent, having increased from a total of $3,515,000 in 1899 to the enormous total of $15,715,000 in 1909.

The electrical industry, as a whole, shows an increase of from $105,832,000 in 1899 to $159,551,000 in 1904, and $243,967,000 in 1909, or the rate of increase from 1899 to 1904 was 51 per cent, while from 1904 to 1909 it was 130 per cent.

Shades of Benjamin Franklin!!

If such accelerated increases continue during the next few decades, the child of our creation will become so enormous in his proportions, we may defy any one to foretell the far-reaching hold the great electrical industry will have upon the future of mankind, and the inexpressible service it will render in the elevation of the human race by bearing its now crushing burdens.

## PERSONALS.

S. K. Colby, of Pierson, Roeding & Co., left last Tuesday on a business trip to New York.

F. W. Gay, a m chanical engineer, with J. G. White & Co., left for New York during the past week.

H. R. Noack, manager of Pierson, Roeding & Co., has returned to his San Francisco office from Southern California.

Clarence Follis, formerly of the Brooks-Follis Company, and now a New York broker, is visiting relatives at San Francisco.

M. E. Launbranch, of the United States Electric Company, of Chicago and New York ,is a recent San Francisco visitor.

W. B. Matheson, of Phoenix, Ariz., has succeeded Frank T. Alkire as secretary of the Overland Telephone & Telegraph Company.

E. S. Harris, who is connected with the Westinghouse Lamp Company, has arrived at San Francisco from East Pittsburg.

A. E. Wishon, manager of the Bakersfield district of the San Joaquin Light & Power Corporation, visited San Francisco during the past week.

Frank A. Cressey, Jr., who is connected with the management of the Modesto Gas & Electric Company, has arrived at San Francisco from Modesto.

H. A. Lardner, manager of J. G. White & Co.'s Pacific Coast branch, left last Monday for the New York office, and will spend three weeks in the East.

H. B. Rutledge has purchased the controlling interest in the Glencoe Electric Light Company, and consequently has permanently located at Glencoe, Minn.

C. E. Groesbeck, one of the vice-presidents of H. M. Byllesby & Co., of Chicago, returned during the past week to his headquarters at Portland, after visiting San Francisco.

Fred L. Webster, Pacific Coast manager for the Allis-Chalmers Company, has just returned to his headquarters at San Francisco, after visiting the company's Los Angeles office.

S. L. Nicholson, sales manager of the Westinghouse Electric & Manufacturing Company, has been paying a visit to W. W. Briggs, assistant sales manager of that corporation at San Francisco.

Robert Mather, chairman of the board of directors of the Westinghouse Electric & Manufacturing Company, spent a few days of last week at San Francisco, after looking over his mining properties in Trinity County.

H. H. Noble, president of the Northern California Power Company, returned to San Francisco last Tuesday after visiting the new Coleman power station, which is to be placed in commission about the last of September.

W. D. Ward, of the Pelton Water Wheel Company, has just returned from a tour of Utah and Co'orado, after securing for his company a contract for a 1000 h.p. water wheel for use in the new municipal electric light and power plant at Longmont, Colo.

A. H. Halloran, managing editor of the Journal of Electricity, Power & Gas, has left on a tour of the Northwest, in the course of which he will attend the Northwest Light & Power Association convention at Spokane, and the Pacific Electrical Jobbers' convention at Portland.

R. A. Thompson, formerly chief engineer of the Wichita Falls & Northwestern Railroad in Texas, has been appointed chief engineer of the California Public Service Commission. Mr. Thompson comes thoroughly equipped to handle his new duties, having served on similar commissions in two other states.

## ELECTRICAL CONTRACTORS' NOTES.

Carl Heilbron, first vice-president, was in Los Angeles last week.

Louis Levy, the manager of the Day Electric Company, spent the past week at Healdsburg with his family.

C. V. Schneider, of the Electric Supply Company, of Sacramento, has just returned from a two weeks' hunting trip in the northern part of the state.

D. T. Gallivan, superintendent for the Newberry-Benheim Electric Company, and Al. Drendall have just returned from a hunting trip in Mendocino County.

John Rendler, president of the California State Association of Electrical Contractors, made a visit to San Diego. President Rendler reports work steady and everyone doing nicely.

Secretary W. S. Hanbridge writes as follows: "A great deal might be said on both sides in reference to the co-operation of lighting companies and contractors, but the following clipping from Emersons Monthly says so much in so few words that it should be readily digested:

" 'The writer happened into one of our warm cities about July 4 this year. There were three contractors in town in addition to the lighting company. The lighting company was selling fans at cost. One contracting firm was heavily stocked with fans that ne could not sell. The other two were busy knocking fans. Can you imagine any one knocking a fan with the heat above 100 degrees in the shade?'

It is futile to hope to increase the sales of fans materially by improper merchandising methods, such as selling at cost, and central stations following that policy are certain to regret it at some later time.

Meanwhile, if some lighting companies insist on following the plan of selling fans without a proper retail profit, the dealers affected can only devote their attention to some more profitable business, and wait for the "light of reason" to break in on the lighting company. Such central stations must sooner or later come to a realization that the active co-operation of all the electrical interests in the community is of considerably more value and will actually result in selling more fans than any policy which eliminates such co-operation."

## TRADE NOTE.

The United States Reclamation Service has recently ordered from the Westinghouse Electric & Manufacturing Company, for installation on the Boise project, Idaho, three 625-kva., 22,000-volt, three-phase, air-blast type transformers. The government has installed on this project a hydro-electric power plant for furnishing energy to moter-driven pumps used for irrigating purposes. As the irrigation season occupies only the summer months, the plant will be kept in part operation during the winter for the purpose of supplying light to the farmers and the small towns on the project.

## NEW CATALOGS.

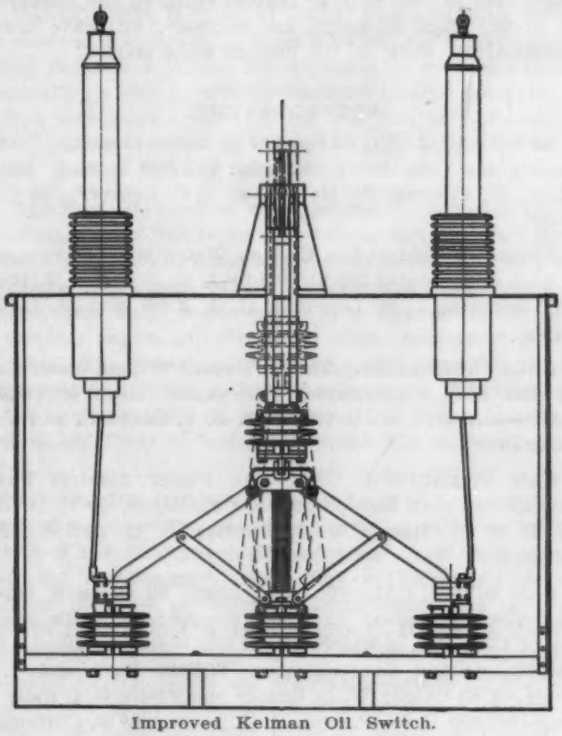
The General Electric Company has just issued a new series of Bulletins. No.4878 is devoted to Cloth Pinions. This remarkable and somewhat radical form of machine element is offered for a wide variety of application in mechanical transmission of power where, because of noise or for other reasons, the meshing of metallic pinions, with metallic gears is impracticable or undesirable. Bulletin No. 4869, is an attractive publication devoted to motor drive for the printing and allied trades. The advantages to be derived from motor drive in this industry are the improved plant location made possible by the use of central station power, reliability, speed variation and control, economy of space, increased production, economy of power, and, what is exceedingly important in the printing trade, cleanliness.

# INDUSTRIAL

## KELMAN OIL SWITCHES AND CIRCUIT BREAKERS.

Apace with the rapid advance in high tension transmission, has been the desire on the part of the manufacturer, tending toward the perfection of the protective apparatus. Especially is this so with high tension oil switches and circuit breakers, as probably no other single piece of apparatus is called upon to act so quickly, effectively and under such severe conditions at times.

The accompanying cut will illustrate a new feature of the Kelman circuit breaker. The operation of this breaker has been described before in these columns, and is based on the well known pantograph mechanism, but employing an improved method of guiding the contacts, and giving them the desired movement. This consists of placing a telescoping guide



Improved Kelman Oil Switch.

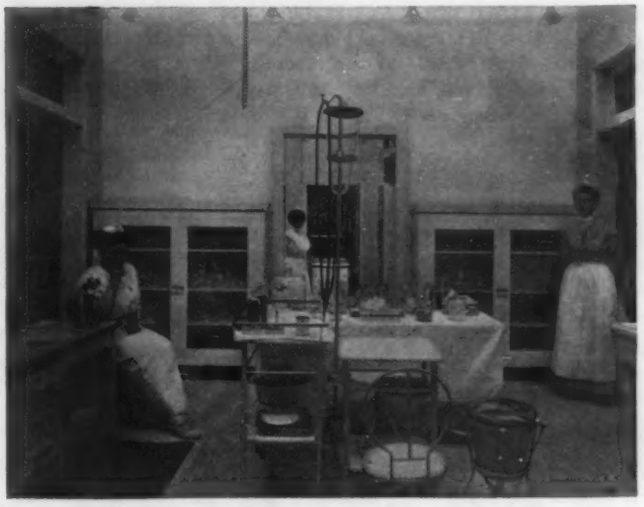
(a) within the pantograph, the outer member being attached to the central insulator (b), and the inner member to the yoke (c). The coiled spring (d) is placed on the guide which is compressed when the switch is closed and is of sufficient strength to open it and hold it in the open position. By this method the contacts are always maintained in correct, but not in rigid alignment, a slight amount of flexibility being allowed, which prevents any undue strain on the porcelain insulator. The compression spring on each guide permits the use of a contact mechanism, which is light in weight, and has very little inertia, such as there is, being absorbed by the springs, thus preventing a shock to the mechanism, even if closed violently. This is an important point, especially in the case of solenoid operated switches, where the voltage of the control circuit varies widely. Another feature of this breaker as will be seen by the cut, is the depth of the terminals in the oil, insuring a larger body of oil over the contacts and consequently greater static pressure to dissipate the arc. One of the most frequent sources of trouble in oil switch operation has been the tendency of the explosive effect to blow the oil out of the tank, when the breaker opens. This type of circuit breaker eliminates entirely, troubles of this kind, by reason of the greater static head of the oil, as the efficiency of the oil varies with the depth of the break.

The horizontal break which has always been a feature of this breaker is also a powerful factor in aiding the rupturing of the arc, as the weight of the oil begins to be effective immediately upon the first movement of the contacts. The placing of these contacts has made it possible to use about one-half the quantity of oil per pole, as would be necessary if the break occurred higher in the oil. These breakers are manufactured for any voltage up to 110,000 both in hand, air and oil.

## THE WESTERN ELECTRIC COMPANY'S NEW HOSPITAL AT HAWTHORNE.

Approximately 13,000 employes of the Western Electric Company are situated at Hawthorne, just outside of Chicago. The company's property at this point occupies more than 150 acres, and here are gradually being concentrated all of its manufacturing activities.

With the realization that it is necessary to look after the welfare of so many workers, the company has recently



Operating Room, Western Electric Co.'s Hospital.

built and equipped an emergency hospital on the grounds. Its object is not only to relieve distress in time of accident, but also to give aid to any who are taken sick while on duty.

Every detail is complete to furnish surgical aid in cases requiring it, this aid ranging from the major surgical class to fine and delicate operations on the eyes. The hospital does not take care of chronic cases, but merely gives aid in acute cases.

This is not a general hospital, but has been organized for emergency work only. Its construction and the arrangement of its rooms have been to carry out the thought of emergency work and to care for accidents that arise. Its services is furnished free of expense to employes.

## TRADE NOTE.

The Olympic Power Company of Fort Angeles, Wash., has recently placed with the Westinghouse Electric & Mfg. Company an order including two 3000 kva. waterwheel generators, seven 1000 kva. water-cooled transformers of 38200 volts, on the high tension, with the usual exciters and an expensive switchboard.

# NEWS NOTES

## FINANCIAL.

PUYALLUP, WASH.—Seventy-five thousand dollars worth of water bonds will be placed on the market by the city within a few months, and the entire system of water supply will be reorganized.

ORANGE, CAL.—At a meeting of the City Trustees a call was issued for an election to be held October 2 to vote on the question of issuing $50,000 bonds for the water department, and $5000 for fire department.

SAN FRANCISCO, CAL.—Suit has been filed in the United States District Court by the Los Angeles Trust & Savings Bank, trustee in bankruptcy of the estate of the San Bernardino Valley Gas Company, asking that the Merchants National Bank, of this city, be required to deliver to the trustees forty first-mortgage refunding bonds of the bankrupt company of a par value of $1000 each, given as security for a note for $15,000, which was renewed from time to time before and after the bankruptcy proceedings. By means of the transactions with the notes and the bonds it is claimed that the Merchants National Bank was enabled to get a greater percentage of the gas company's bonds than other creditors. It further is stated that out of an authorized bond issue of $1,500,000, to the amount of $184,000 were sold and $648,000 held as collateral for loans, $400,000 of which were so placed that they might be sold by the lenders. An order was issued by Judge de Haven directing the Merchants National Bank to show cause September 11 why it should not be permanently restrained from disposing of the bonds.

## ILLUMINATION.

KALISPELL, MONT.—Property owners of this place are petitioning the creation of a lighting district for the installation of an up-to-date lighting system.

EUGENE, ORE.—J. H. Causey & Co., of Denver, has been awarded the contract for a $57,000 light, power and water bond issue. The firm offered a premium of $230.

LOON LAKE, WASH.—Gerhke & Sons, proprietors of the local planing mill, have received offers from outside capital to finance an electric light plant, to be operated in connection with the mill.

PEARL HARBOR, H. T.—The contract for furnishing boilers for an auxiliary power plant equipment at the naval station at this place has been awarded to C. C. Moore & Co., of 99 First street, San Francisco, at $158,000.

NAMPA, IDAHO.—J. A. Jones has been granted permission to construct and maintain a gas plant in Nampa and to use the streets and alleys for laying pipe lines on condition of repairing the same, for a period of 25 years.

CENTRALIA, WASH.—The Tenino Light & Power Company, recently taken over by the Washington-Oregon Corporation, has applied for a franchise to construct a pole line through this city, and extending from the City of Tenino to Chehalis.

GREAT FALLS, MONT.—The Great Falls Gas Company states that work has practically started on an addition to its plant. The new addition, which will cost $40,000, will double the capacity of the plant, and A. E. Potter, general manager of the company, is here to supervise construction work.

BAKERSFIELD, CAL.—Rio Bravo will soon have natural gas pipes in to operate the many pumping plants recently installed there. The gas company plans a system to cost approximately $25,000. Among those who were present at the meeting were Messrs. Hegg, Knight, McClellan, Van Dunn and Updike.

VALLEJO, CAL.—The Pacific Gas & Electric Company applied for permission from the City Council to tear up Santa Clara street, between Virginia and Capitol streets. The company wants to put down a six-inch main for gas.

PALMS, CAL.—A committee, with S. A. Sterns as chairman, composed of one resident of each street in Palms, has agreed to install seventy-five electric lights in the streets of this vicinity beginning October 15. The plan is approved by the contributors in the assessment district.

PRINCE ALBERT, SASK.—The ratepayers of this place have endorsed by-laws to raise the sum of $775,000 for the development of 3500 h. p. at Lacolle Falls, on the Saskatchewan River. Cecil F. Smith, the engineer, will have charge of construction work on the project when started.

## INCORPORATIONS.

SAN FRANCISCO, CAL.—The West Sacramento Electric Company has been incorporated for $100,000 by B. P. Lilienthal, H. W. Furlong, W. Herlitz, T. T. C. Gregory and C. J. Goodell

ESCALON, CAL.—The Escalon Water & Light Company has been incorporated for $10,000 by J. W. Smith, S. T. Irwin, H. T. Brennan, J. N. Leighton, H. J. Alley and H. L. McPherson.

FULLERTON, CAL.—The El Modent Mutual Water Company has been incorporated, with capital stock of $43,000. The directors are: F. E. Crawford, E. V. Crawford and G. B. Lancaster.

SAN FRANCISCO, CAL.—The Placer Electric Power Company has been incorporated for $2,000,000, by R. H. Borland, F. W. Nightingill, R. T. Harding, N. C. Butler and I. Lindemann.

SAN DIEGO, CAL.—The San Diego, El Cajon & Escondido Railway Company has been incorporated, with capital stock of $2,250,000, of which $60,000 has been subscribed. The incorporators and directors are: William Stell and C. O. Nichols, of El Cajon; W. L. Ramey and Frank C. O'Kelly, of Escondido, and G. W. Purcell, H. G. Crowe and C. C. Riordon, of San Diego.

## TRANSMISSION.

TENINO, WASH.—The Tenino Light, Power & Water Company has filed acceptances and bond for franchises granted recently by the Municipal Council of this city.

LOS ANGELES, CAL.—The F. O. Engstrom Company has been awarded the contract, at about $10,000, for the erection of a re-inforced concrete substation at Colton for the Southern California Edison Company.

VALE, ORE.—L .L .Nunn and others, of Salt Lake City, connected with the Telluride Power Company, were in this city recently, looking over local conditions preparatory to making arrangements for the erection of a power plant.

SPOKANE, WASH.—The engineering work is now in progress on the plan of the electrical power development of the Kootenai River at Kootenai Falls, Mont., to cost $6,000,000, which is destined to furnish the northwestern portion of the Inland Empire with electrical power. The promoter of the enterprise is J. A. Coram of Boston, Mass. The plant is to be located 7 miles east of Troy and 11 miles west of Libby, Mont.

TWIN BRIDGES, MONT.—The survey of the Madison River Power Company's power line from Ruby to this city has been completed. The line will follow the Northern Pacific track from Laurin and will be built outside of the right-of-way fence.

PRINCE RUPERT, B. C.—Special election has been voted to be held in September on a by-law providing for the construction of a municipal hydro-electric system, creating a bond indebtedness of $550,000. It is proposed to transport water from Lake Woodworth and establish two systems, one for power and the other for water.

SAN JOSE, CAL.—That the Great Western Power Company intends coming into San Jose, and will probably erect a steam plant in this city without delay to furnish electric power and lights until the long distance transmission line is constructed was the significant statement made by Leo D. Haas. Mr. Haas figures that his company will expend close on to $250,000 in this city.

VANCOUVER, B. C.—C. C. Moore, Henry building, Seattle, has received a contract, at about $250,000, for the installation of four Babcock & Wilcox boilers, 500 h. p. each, and capable of operating a 2000 k. w. Allis-Chalmers turbine generator. A 260-foot reinforced concrete stack will also be built, and the system will be installed in the power plant of the British Columbia Electric Railway Company.

FRESNO, CAL.—The first carload of material for the Los Banos power line to be built by the San Joaquin Light & Power Company, are being sent out from Fresno. The work of transporting the wires, cables, poles and transformers will require some time. A few cars will be sent out daily. Work on this line, which will tap a rich alfalfa country, is to begin at once. The extension is to be made from the Madera county power line, and will be 80 miles long. It is to be completed by the middle of November. Dos Palos, Los Banos, Gustine and three or four other towns will be supplied with power.

RIVERSIDE, CAL.—Manifold & Poole of Los Angeles are the engineers for the new power system to be established in San Barnardino, Riverside and other Southern California towns by the Southern Sierra Power Company. The contract for the steel posts for the transmission line to be constructed from plants in Inyo county to Riverside has been awarded to Milliken Bros. of New York. The contract for installing all machinery and drawing the plans for the buildings for the steam plant which will be erected at San Bernardino has been awarded to C. C. Moore & Co., of Los Angeles. This plant will cost $200,000 and will be used until the power from the water power plants becomes available.

CORONA, CAL.—S'nce the filing of articles of incorporation of the Southern Sierras Power Company and Sierra Construction Company in Riverside, developments have been following rather thick and fast. These companies, whose stockholders are prominent Denver capitalists, have been represented in this section by F. A. Worthey of Riverside. The contract for a steam plant to cost in the neighborhood of $300,000 has already been let. This is to be located in the vicinity of San Bernardino, the exact location not having yet been made public. The new company has let contracts for transmission and distributing lines to tap this section as well as the Moreno and Perris Valley and West Riverside sections. It seems probable also that extensions will be made to Elsinore.

## TRANSPORTATION.

SALEM, ORE.—It is reported that the Oregon Electric Company will begin construction work at once on the extension from this place to Albany.

WATTS, CAL.—The City Council has passed an ordinance granting to the Pacific Electric Railway Company the right to construct and for a period of fifty years to maintain and operate an electric railway upon certain streets of this city.

PACIFIC GROVE, CAL.—The Monterey & Pacific Grove Street Railway Company are planning to extend their line from Nineteenth street in this city by the way of Lighthouse avenue and Willow street and Spruce avenue to the Presidio of Monterey.

RIVERSIDE, CAL.—The City Council will receive sealed bids up to Sept. 26 for the purchase of a franchise granting the right to construct and for a period of forty-five years to maintain and operate a double track electric railroad on certain public streets of this city.

SALEM, ORE.—At a special meeting of the local municipal council the ordinance granting a franchise to the Portland, Eugene & Eastern Railway to operate a street railway here, was repealed. The company, which has franchises in Eugene, Albany and other towns, is charged with failure to comply with the terms of its franchise.

CARSON CITY, NEV.—D. W. Williams is in Oakland on a trip connected with a scheme which, if it bears fruit, will be of the greatest benefit to Carson City. Mr. Williams is endeavoring to raise capital enough to put in an electric line between this city and Glenbrook. Half a million dollars, it is estimated will build and equip the road and within three years' time Mr. Williams believes that it will be a paying investment.

SALEM, ORE.—The Oregon Electric Road, a Hill line, will continue the present line which terminus is Salem and will run a road to Albany. A right of way has been secured, with the exception of a few property owners who are holding out. The company has sent out four crews of surveyors to work the line. Bids for the construction of the road have been received from three companies, but on account of the right-of-way controversy the bids were not opened.

SAN FRANCISCO, CAL.—Work has been begun on the Sacramento and Woodland electric road, a part of the Northern Electric system. The line will be inoperation by May, 1912. It will traverse the West Sacramento property, the Bright lands and following the river, will reach Elkhorn, thence to Woodland, a total distance of 19½ miles. It will pass over the tules on a 15-foot grade, the roadbed also serving as a levee. The line will give Woodland access to the Western Pacific at Sacramento and to the Santa Fe at Stockton over the Central California Traction rails.

WENATCHEE, WASH.—The Wenatchee Traction Company has received a franchise along Wenatchee avenue for the construction of a street railway system and as a portion of an interurban line that will eventually extend along the Columbia River Valley from the town of Cashmere to Beverly, connecting at the latter point with the Chicago, Milwaukee & Puget Sound Railway. The company states that 100 miles of electric road are contemplated. The officers of the company are: L. W. Pratt, president; Henry Hewitt, vice-president, and Walter M. Harvey, secretary and counsel, all of Tacoma.

## TELEPHONE AND TELEGRAPH.

ELGIN, ORE.—Citizens of Union and Wallowa Counties have organized a company and will construct a phone line between the two places.

PLUMMER, IDAHO.—The Plummer Home Telephone Company has completed organization. The officers are F. H. McCaslin, president; R. Malvon, vice-president; R. L. Stout, secretary; H. Mercer, treasurer, and R. A. Malcern, general manager.

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SAN FRANCISCO, CAL. Sept. 11, 1911.

Mr. E. B. Strong, President
Technical Publishing Co.,
604 Mission St.,
San Francisco, Cal.

Dear Sir:-

It will probably be of interest to you to know something about the results from our advertising in the Journal. A short time ago we received an inquiry, which to date is the long distance record.

Among other inquiries in answer to one of our ads covering mine telephones and other special equipment for mines is one from a concern in Constantinople. This concern not only inquires for prices on this equipment, but also is figuring on handling our entire line throughout Turkey.

Yours very truly,
KELLOGG SWITCHBOARD & SUPPLY CO.
Per H. Heidenreich
Pacific Coast Sales Mgr.

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